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OCEANOGRAPHY: SCOTLAND'S INTEREST IN ITS PROGRESS

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The review, in the last issue of the *Magazine*, of a recent American volume, *The Oceans: Their Physics, Chemistry and General Biology*, draws attention to a modern and still comparatively young science in which Scotland's former active and, indeed, leading interest has very markedly declined during the past twenty years or so, almost in inverse ratio to the rapidity with which the science has developed in the same period. It may be opportune, therefore, to review the share previously taken by Scotland, especially from its capital city, in the establishment of this modern science which still holds ample promise of further and highly significant expansion.

Oceanographers the world over are wont to cite the famous *Challenger* expedition (1872-1876) as having laid the foundation for the modern science of oceanography. Scotland, however, and more particularly Edinburgh, had already by that time established more or less a tradition in oceanographical research of which the *Challenger* expedition was, most fittingly, the glorious culmination.

The seeds of this tradition, as was recently pointed out by Professor James Ritchie,[1] were very probably sown about one hundred and forty years ago by the famous whaling expert, William Scoresby, in the classroom and around the dinner-table of Professor Robert Jameson, the incumbent for no less than fifty years (1804-1854) of Edinburgh's Natural History Chair. Scoresby was already an expert in whaling, when, as a youth of twenty or so, he attended Professor Jameson's classes in 1806 and again in 1809; and what probably happened, as Professor Ritchie so delightfully recounts, was that Scoresby, encouraged by his Professor, expounded among his fellow-students the first-hand knowledge of whales and whaling which he had acquired in the best of schools and which Professor Jameson had become aware was greater than that possessed by anyone else. Professor Ritchie suggests that Scoresby's influence on Professor Jameson's teaching, and so upon the generation of students that followed him, was probably greater than anyone suspected. However that may be, the remarkable fact is that scarcely an exploratory sea voyage took place from Britain during the first half of the nineteenth century which did not include, as the selected scientific member of the expedition, one who had been a student under Professor Jameson. Nor does this end the scientific romance which was evidently begun by Scoresby. It is indeed but the beginning.

In 1831, Edward Forbes, a young Manxman of Scottish descent, came to Edinburgh to study medicine. He attended, of course, Professor Jameson's class in Natural History. Whether or not it was there that he was introduced to a new invention called "the naturalist's dredge," there is not doubt that by none

was the new weapon more enthusiastically received or more assiduously applied. Forbes's interest, or, rather, lack of interest, in medical matters thereafter can be adjudged from the following facts.

Commencing work with the dredge in the year following his advent to Edinburgh, he pursued it to such purpose that not only was he able, in 1839, to expound his results with such effect to the British Association that a " Dredging Committee " was constituted to develop a work of such obvious promise, but also, in a comparatively short time and at an early age, for Forbes was scarcely forty when he died in 1854, he came to be recognised as " the most original, brilliant and inspiring naturalist of his day." His death less than eight months after his appointment to what we are told was the goal of his ambition, namely, the Natural History Chair at Edinburgh University, was a sad blow to the scientific circles which he graced no less by his wit and humour than by his erudition.

Forbes left, nevertheless, a rich heritage to those who followed him. Strangely enough, though by no means a unique instance of the kind in scientific annals, of the seed of this heritage, it was that which was probably least expected to bear fruit of any sort—a negative result in short—which has since produced the richest harvest of all. In a brilliant exposition to the British Association at Cork in 1843, of the results of his dredging operations in the Mediterranean two years before, Forbes defined among the bottom-living communities of the Aegean Sea, where he had dredged to the then record depth of 230 fathoms, eight depth-zones, each characterised by its peculiar assemblage of animals. More significant, however, from the present standpoint, and almost as an afterthought one feels on reading the paper, he " conjectured that the zero of animal life would probably be found somewhere about 300 fathoms." The region below this depth Forbes designated the " Azoic Zone "—devoid, that is, of animal life.

The theory of zones of distribution has, in the main, stood the test of time and of vastly extended observations. Forbes's conception of the Azoic Zone, on the other hand, did not endure very long. Foremost among those who came to doubt and finally to disprove the theory was Charles Wyville Thomson, a later incumbent of Edinburgh's Natural History Chair. Forbes was at the height of his eminence when, in 1847, Thomson entered the University as a medical student. He abandoned medicine in 1850, when he left the University on account of ill-health. Thereafter he turned his whole attention to science. From a lectureship in Botany in Aberdeen University, to which he was appointed in 1851, Thomson went in 1853 to Queen's College, Cork, as Professor of Natural History, and thence to Belfast, where he was successively Professor of Geology from 1854 and Professor of Zoology and Botany from 1860.

It was at Belfast that Thomson's real interest in marine life began and he, too, became an enthusiastic dredger. The question of life in the depths of the sea attracted him in connection with palæontological studies which led him to visit Norway in 1866 to see a collection of rare, living specimens dredged from depths of more than 300 fathoms—Forbes's zero depth—from the Norwegian fjords. This visit to Professor Michael Sars and his son, George Ossian Sars, seems largely to have resolved in Thomson's mind any remaining doubt as to the validity of the Azoic Zone theory, a doubt probably engendered first of all by discoveries like that of Fleeming Jenkin in the Mediterranean in 1860. This engineer, who was later (1868) to become the first Professor of Engineering in the University of Edinburgh, observed several kinds of animals firmly attached to the parts of a broken telegraph cable when these were raised from a depth of more than 1000 fathoms. At all events, soon after his return from Norway, Thomson set about devising the means of putting to conclusive proof his growing conviction that life was to be found generally in the sea at depths greater than 300 fathoms. To this end he succeeded in obtaining a loan from the Admiralty of H.M.S. *Lightning* for a few weeks in the summer of 1868, to pursue investigations in the deep water north-west of the British Isles—the region, in fact, which was earlier suggested by Forbes as that in which his theory might be put to the proof.

Because of unusually bad weather and the consequent misbehaviour of their "cranky little vessel," as Thomson afterwards described it, not a great deal was accomplished on the *Lightning* cruise, but enough to show that the theory propounded in Forbes's name was almost certainly erroneous. To decide the matter more conclusively, the Admiralty provided the investigators with a more suitable vessel in the following year, and much more than was even expected was successfully overtaken in the same region in 1869 by H.M.S. *Porcupine*. Not only were living animals found at depths far in excess of 300 fathoms, but numbers of these were at that date new to science.

New species of animals, however, were not the only significant discovery of the *Lightning* and *Porcupine* expeditions. Up to that time a curious fallacy had persisted in relation to the temperatures obtaining in deep ocean waters. This was that, below a certain depth, the temperature of the water remained constant at 4° C., the maximum density point of fresh water. A secondary object of the above cruises, therefore, was to settle, if possible, this question of deep-sea temperatures. Despite the imperfections of the instruments used—the development of accurate deep-sea thermometers has since been an enterprise in itself in oceanographical science—the question was conclusively settled, and in the settling of it a discovery of signal importance to oceanography was made. As was expected, temperatures in the Faroe-Shetland Channel region, where these investigations took place, were found, as in most other regions, to diminish from the surface downwards; but, whereas in some places, below depths of between 200 and 300 fathoms, the fall in temperature was discovered to be very little below a temperature, at these depths, of considerably *above* 4° C., at other nearby positions the fall in temperature after 200-300 fathoms continued at only slightly diminished rate to *less than zero* in depths of 600 fathoms and beyond. Moreover, the region in which such very low temperatures were registered was, to all appearances, contiguous with that in which there was no such rapid diminution in equivalent depths. It was only subsequently, from comparable experiences among the East India Islands on the *Challenger* expedition, that the true explanation of these deep-water temperature differences emerged.

Still more significant, however, in view of later developments, was the discovery that the bottoms of these two dissimilar regions were inhabited by two correspondingly distinct and radically different assemblages of animals, for this was, in fact, the first practical demonstration under natural conditions of the dependence of marine organisms on their physical environment. That the discovery was a pregnant one is evident from recent oceanographical advances in connection with fishery investigations. The features, however, of the two expeditions which held the imagination for the time were, first, that animal life existed in all probability in the greatest depths of the sea, and, second, that many hitherto unknown forms of life inhabited the seas and oceans of the world.

It was in order to investigate these great questions that Thomson, soon after he had succeeded, in 1870, Professor George J. Allman—also an investigator of note in marine zoology—in the Chair of Natural History in Edinburgh, petitioned the Government through the Royal Society of London to equip an expedition adequately to explore the types and conditions of life in the great oceans. Approval and consent given and a vessel allocated, Professor Thomson so threw himself into the work of preparation that, towards the close of the year 1872, all was in readiness. The vessel, H.M.S. *Challenger*, was rigged and equipped, scientific apparatus and gear, much of it of new design, assembled, the scientific staff selected and appointed, with Professor Thomson, as Director, at their head, when there occurred one of these fortuitous happenings but for which the subsequent course of the enterprise might have been very different. At the last minute one of the scientific staff had perforce to resign his appointment.

At that time there was working in Professor P. G. Tait's physical laboratory in Edinburgh University a young student, Canadian-born of Scottish descent, who, like Forbes and like Thomson before him, had relinquished medicine for science. John Murray had already had experience in oceanographical work

when, on Professor Tait's strong recommendation, he was offered and accepted the vacant post on the *Challenger's* scientific complement; surely, as one of Professor Thomson's distinguished pupils later expressed it, "one of the best examples in the history of science of the right man being chosen to fill a gap." Murray was the second member of the scientific staff, apart from the Director, to be chosen from Edinburgh. The other was Mr. J. Y. Buchanan, the chemist.

The *Challenger* expedition sailed from this country in December 1872, and for nearly three and a half years traversed the great oceans, sounding, dredging and examining the properties of the sea itself. Reports which arrested and excited the interest of scientists the world over came home from various ports of call, and great "samples" of the collections taken were deposited in the British Museum to await the return of the expedition. Long before this time arrived—May 1876—it was known beyond any shadow of doubt that greatness beyond mere success had been achieved. When eventually the expedition returned, Professor Thomson was appointed Director of the *Challenger* Expedition Commission established in Edinburgh to arrange for the distribution and investigation of the vast collections and for the publication of results. From then onwards, for nearly twenty years, Edinburgh was the world-centre of oceanographical research, attracting marine investigators from far and wide.

Unfortunately, the heavy administrative responsibilities thus assumed by Sir Wyville Thomson, as he now was, following so closely upon the mental and physical strain of such a lengthy voyage, soon began to undermine his health. Compelled on this account to resign both his professorship and the Directorship of the *Challenger* Commission in 1881, he died early in the following year at his ancestral home of Bonsyde, near Linlithgow. It is an index, however, of his tremendous enthusiasm that, despite the pressure of his immediate responsibilities, which must indeed have been heavy, Sir Wyville Thomson, before he died, found time to arrange and direct another expedition to confirm his conjecture regarding the "warm" and "cold" bottom areas of the Faroe-Shetland Channel. As already indicated, similar conditions had cropped up in the East Indian Archipelago during the *Challenger* expedition, and from circumstances as they were found to be in that region Thomson deduced that the two physically different, and apparently contiguous, deep water-masses of the Faroe-Shetland Channel, as found on the *Lightning* and *Porcupine* cruises, must in fact be separated by a submarine ridge. The *Knight Errant* expedition of 1880, conducted by Captain Tizard, who had been the navigating officer of the *Challenger* expedition, and by Dr. John Murray, found the ridge which was appropriately named after Sir Wyville Thomson. Yet another expedition in H.M.S *Triton*, which Sir Wyville did not live to see, visited the same area in the summer of 1882, with Murray and Tizard again in charge, and confirmed once more the evident effect of different environmental conditions on the nature of the animal populations on either side of the Wyville Thomson Ridge.

And now, after Sir Wyville's death, the man whose association with the *Challenger* expedition had begun almost Cinderella fashion, became its chief promoter in bringing it to a magnificently successful issue. The fifty large quarto volumes, five of them on his own work, in which, within twenty years of the return of the expedition, its results were set forth to the world, are a lasting memorial to the capacity and energy of Sir John Murray, as he became soon after this work was done, in the performance of his tasks in the Office of Director in which he succeeded his great leader. The practical work for these voluminous reports was centred in the *Challenger* Office at No. 32 Queen Street, Edinburgh. Some of it, however, was done in the laboratories of the University, and, in addition to the staff of the Commission, other prominent scientific men of Edinburgh took a large share in the investigations. The names of Sir William Turner, Professors P. G. Tait, Crum Brown, Chrystal, and Sir Archibald Geikie, Dr. J. Y. Buchanan, Dr. John Gibson, and Dr. Alexander Buchan, testify to researches ranging over a wide field in the physics, geology and chemistry, as well as in the biology, of the sea.

No less remarkable achievements to the credit of Sir John Murray were, first, his discovery, from a sample of rock sent to him for examination along with *Challenger* samples, of the valuable phosphatic deposits of Christmas Island, and second, his inducement of the British Government to annex the lonely, uninhabited island, and to give to a company which he formed the concession to work the deposits. The island was colonised and developed with such success that, by 1910, Sir John was able to show that the British Treasury had received, in royalties and taxes, sums which more than covered the cost of the *Challenger* expedition.

"It has been said," wrote Sir William Herdman, a pupil of Sir Wyville Thomson's, "that the *Challenger* expedition will rank in history with the voyages of Vasco da Gama, Columbus, Magellan and Cook. Like these it added new regions of the globe to our knowledge, and the wide expanses thus opened up for the first time—the floors of the oceans—were vaster than the discoveries of any previous exploration." Its immediate and practical effects were widespread and far-reaching. Oceanographical expeditions of various scope were, even before the completion of the *Challenger* enterprise, sent out by almost every maritime nation of the world. Marine biological laboratories, great and small, came into existence far and wide. Groups of scientists, often commissioned by their respective governments, became the national foci of oceanographical investigation and interest. Oceanography had, so to speak, come into its own, was recognised as a worthy and possibly a valuable pursuit, and was duly accorded the status and dignity of a science.

Nothing more natural, therefore, than that intelligent fishery interests should about this time begin to employ the methods of scientific investigation at sea, and here again we find Scotland and Scottish scientists in the van of progressive thought and enterprise.

In 1882 the former Board of the British White Herring Fishery was dissolved and replaced, in Scotland, by the Fishery Board for Scotland. Scientific investigations were among the Board's original terms of reference, and in its earliest Annual Reports are to be found numerous pioneering papers on scientific investigations relating to fisheries. Professor J. Cossar Ewart of Edinburgh, Professor W. C. McIntosh of St. Andrews, Mr. W. E. Hoyle, Mr. Thomas Scott, Mr. W. L. Calderwood, Dr. Hugh Robert Mill and Dr. John Gibson on the physics and chemistry of the sea around Scotland, and several more well-known names are among the earliest contributors to the Board's scientific activities. An Edinburgh graduate, Dr. T. Wemyss Fulton, was the Fishery Board's first Scientific Superintendent, appointed in 1888 to be employed full-time on marine research in relation to fisheries. His, too, were substantial contributions to the development of fishery science as this branch of oceanography grew apace in the eighties and nineties of last century, and thenceforth, on account of the economic significance of fishery problems, provided the main stimulus to oceanographical investigation.

It soon became apparent that joint endeavour by at least several nations would be of great advantage in this field. The opportunity of co-ordination of effort thus visualised was afforded by the establishment, in 1901, of the International Council for the Exploration of the Sea, with headquarters, first in Christiania (Oslo), but later transferred to Copenhagen. Practically all European countries, with fishing interests in North European waters particularly, became affiliated to this Council and investigative work of the highest order began to take place under its aegis, not the least of which was a thorough overhaul, improvement and standardisation of the methods and implements of marine research.

Scotland, under the Fishery Board, took a full share from the beginning in researches sponsored by the International Council. Other Scottish pioneers in fishery research under the Board, besides Dr. Fulton above-mentioned, were Professor (now Sir) D'Arcy W. Thompson, appointed Scientific Member of the Board in 1898, and the late Dr. Alexander Bowman of Aberdeen, both of whom, in connections of forty-one and thirty years respectively, have contributed many valuable researches bearing upon fisheries.

Side by side with progress in this field, progress which in the present century

has been both extensive and rapid, the oceanographical tradition of Scotland has been further and richly upheld in the field of Polar Exploration by the late Dr. W. S. Bruce, Director, for fourteen years before he died in 1921, of the now defunct Scottish Oceanographical Laboratory at the Surgeon's Hall, Edinburgh.

William Spiers Bruce was the fourth Edinburgh oceanographer to commence his University career as a medical student, and the fourth to abandon medicine for the science to which, in his case, he was introduced by Sir John Murray on the latter's floating laboratory, " The Ark," set up in 1884 as a training ground for students in oceanography in the old sea-flooded quarry at Granton. Bruce's polar work began in 1892 on a Dundee whaling expedition to the Antarctic, but it is with the Scottish National Antarctic Expedition on the *Scotia* (1902-1904) that his name is chiefly associated, and on which his work in the Weddell Sea was of such value to later Antarctic ventures. Lacking perhaps that sensationalism in its achievement which makes instant public appeal, Bruce's investigations in both polar regions were often closely related to economic enterprise, and were carried out in the face of heavy odds.

Tradition alone, then, provides a strong argument in favour of the continued promotion of oceanographical science in Scotland, and especially perhaps from its capital city. There are, however, other and more practical reasons in support of such advocacy.

In its modern development, so comprehensively surveyed in the volume mentioned at the beginning of this article, oceanography is of the nature of a composite science, drawing freely upon mathematics and various branches of biology, physics and chemistry. None the less, it has very definite claims to be regarded as a primary subject, the study of which will undoubtedly continue to make, as it has made in the past, fundamental contributions to those very sciences upon which it draws so freely. Oceanography treats of a world which lies beneath the surface of the sea, and that surface, geographical readers need scarcely be reminded, comprises nearly three-quarters of the surface of the earth.

In the study of the sea itself—especially in the study of its movements, which exercise a very large measure of control over practically all that happens in the sea—new physical principles have had to be enunciated to describe and to explain these movements, and new methods devised, calling for considerable extensions in our mathematical and other equipment, to investigate them.

Likewise, in the investigation of the inherent properties of sea water and their variations, new refinements have had to be introduced into the methods of analytical chemistry before many of these properties could be quantitatively assessed in the first instance, and before the small but highly significant variations to which they are subject could be evaluated with the necessary accuracy. Physical, including chemical, oceanography is essentially an exact science.

Again, the study of living organisms, plant and animal, in the open sea—these being generally of the most primitive forms—has undoubtedly a significant contribution to make to the whole complex problem of the riddle of life. Sea water, being more uniform in its properties, is altogether a more favourable environment for living organisms than is the air. Because of this it may reasonably be anticipated, as an American scientific writer has suggested, that " the underlying relationships between the living plant or animal and its physical-chemical surroundings, as well as between different groups of organisms, will more readily be elucidated in the sea than on land."

Another direction in which the study of oceanography has of late years assumed increasing significance is in relation to geology. The reason for this, in the words of Professor R. A. Daly of Harvard, is that " the major mysteries of land geology itself are planetary and to a large extent their secrets lie hidden under the ocean." [2]

As a cultural pursuit, therefore, oceanography ranks with other primary terrestrial and cosmic subjects like geography, meteorology and astronomy, and may claim with them a due share of the interest of intelligent people.

Passing to what may be characterised as utilitarian aspects of the subject,

mention has already been made of the most outstanding one up to the present, namely, its extremely practical and intimate bearing on fisheries. A major problem for solution in this field, as contributory to the rational exploitation of a natural food-resource which has again and again been shown by experience to be by no means illimitable, is that of the causes of natural fluctuations in the abundance of the principal food-fishes. These natural fluctuations have sometimes been quite considerable, even catastrophic, in their effects on commerical enterprise.

It has been demonstrated fairly conclusively since the commencement of scientific fishery investigations, that fishes are very closely dependent, not merely for their maintenance and general well-being, but for their very existence, on certain factors in the sea itself. It would seem, in short, that the root causes of natural fluctuations in the stocks of fishes lie in fluctuations in the characteristic properties of the sea, and that the service which commerical sea fisheries require of oceanography, more particularly of physical oceanography, is akin to the service rendered by meteorology to agriculture and similar undertakings on land. At all events, there can be little doubt that this and other aspects of applied marine biology—the development of the seaweed industry for example —are in need of further detailed, factual knowledge of the physics and chemistry of the seas around our coasts and over at least the chief fishing regions. In virtue of her geographical position, not to mention her facilities in other directions, Scotland is particularly favourably placed for the acquisition of this knowledge.

By far the most significant of the physical features of north-west European waters is the warm and relatively salt drift-current which emanates from the still warmer and salter waters of the Gulf Stream and courses northwards off our western seaboard. It is known that this powerful drift-current fluctuates widely in the intensity and volume of its flow, with corresponding variations in the distribution in the North Sea and neighbouring regions, of the warm and salt water it bears from sub-tropical, through temperate, to sub-Arctic and even Arctic latitudes. Modern hydrodynamical methods permit of the measurement of these fluctuations, and it is now fairly clear that probably the most convenient place to effect this measurement is in the region of former Scottish pioneering efforts, namely, the Faroe-Shetland Channel, since the Wyville Thomson Ridge would appear to be the threshold over which passes practically all the oceanic water entering into and influencing in remarkable degree the seas of north-west Europe.

Still another " utility " aspect of oceanography derives from the fact that the sea contains at least a trace of every element known to the chemist. Most of these are present in such extreme dilution that economic extraction on a commerical scale has hitherto defied all efforts to that end. Nevertheless, the extraction of certain elements is, today, an actual and successful commerical undertaking in America, where potash, bromine and magnesium are even now being taken from the sea on a commerical scale. As Professor E. F. Armstrong points out, " once the technique of handling large quantities of sea water at low cost has been further elaborated, the sea is a potential source of such valuable minerals as copper, manganese, lead, aluminium, tin and vanadium." Professor Armstrong also draws attention to the possibility of it becoming a matter of necessity, a generation or so hence, to recover phosphate from the sea. Scotland, with its extensive coastline, should be alive to these possibilities.

Finally, and indirectly through meteorology, oceanography will almost certainly come to render important services to agriculture, trade and industry, for while the atmosphere exerts certain influences on the sea, very much greater influences are exerted by the sea on the atmosphere. This consideration is linked with the question of long-range, seasonal, weather-forecasting, the possibility of which need only be mentioned in order to visualise the enormous benefits which would accrue therefrom to many of man's interests and day-to-day pursuits.

These are only some of the expectations which are associated with the advancement of oceanographical science. It will be observed that the emphasis is mainly

upon physical oceanography as having now the greater potential for advance in itself and, through itself, for advances in other branches of the science. Until about 1920, oceanography developed mainly and strongly on the biological side, due in great measure to the impetus derived from the economic pressure of fishery problems. Since then, as evidenced in the volume mentioned in the opening sentence of this article, there has been a rapid and remarkable expansion in physical oceanographical investigation, due largely to the growing appreciation of the primary importance of the environmental issue in the study of marine life.

In consequence of these developments, while biological oceanography is now well served in Scotland, as in Britain as a whole, by the Universities and in a number of institutions, including Government and other publicly endowed laboratories, there is in this country no single institution whose primary business it is to acquire and to disseminate scientific knowledge of the sea itself, knowledge which as above indicated is not only of interest, but is material to human welfare and advancement. The subject is, of course, included in support of the work carried out in marine biological laboratories such as those at Plymouth, Aberdeen, and Millport. That the deficiency, however, has already been noticed is evident from a recent leading article in *The Field*, in which is somewhat forcefully advocated the establishment of a national institute of oceanography in which, without prejudice to the activities of existing establishments, oceanography will have " its proper honourable place among our national activities."

Comparing conditions in other countries, Norway, for instance, with a smaller population than that of Scotland, has, in the chief department of the Geophysical Institute in Bergen, an organisation entirely devoted to marine physical research. The Institut für Meereskunde in Berlin also, if it still exists, is, or was, wholly given over to physical oceanographical investigation, and in America, the Scripps Institution of Oceanography in California, while it includes a biological department, aims chiefly at developing physical oceanography. A department of physical oceanography also forms an integral part of the Oceanographical Institute in Paris,[3] which was founded by the late Prince of Monaco in 1911, and in the technical and scientific direction of which Britain was for a time represented by three eminent Scottish oceanographers whom we have already mentioned, namely, Murray, Buchanan, and Bruce.

Scotland, therefore, surely owes it to herself, as well as to the goodly number of her sons who have such a noble record of service in this field so pre-eminently her own in days not so long past, not merely to maintain, but to enhance the heritage thus bequeathed to her. The establishment, it is suggested, of a Scottish Institute of Oceanography would unquestionably be the most appropriate and advantageous means not only of discharging this indebtedness to the past, but also of furthering Scottish tradition in the development of a science obviously possessing enormous potentialities both theoretical and practical.

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REMOTE ISLANDS OF THE SOUTHERN INDIAN OCEAN

By C. R. V. Gibbs

The Southern Indian Ocean possesses a generous share of islands, although with the exception of Mauritius and Réunion (and, of course, the large mass of Madagascar) none are of any consequence, and, if Cocos and Christmas be ignored, they are restricted to the western half. All but Mauritius and Réunion lie well away from the shipping lanes. Those between the Equator and 15° S. (Seychelles, Chagos, etc.) are coralline formations, many of them inhabited and producing small quantities of copra for shipment to mainland Africa in small craft, generally sail. South of these, Mauritius and the adjacent Réunion are of considerable size and mountainous, organised colonies of Britain and France respectively, and served by mail steamers. The remote islands of the Indian Ocean lie south of these again—Amsterdam and St. Paul in 38° S. and the remainder from eight to seventeen degrees still further from the Equator. The most remote are over 2000 miles from inhabited land and the nearest something like half that distance. All are uninhabited and, excepting Kerguelen, small, but most rise to at least 1000 feet above the sea. They are claimed by France, which regards them as dependencies of Madagascar. (Incidentally this is the only portion of the Great Southern Ocean where Great Britain does not claim all the outlying islands.) The islands south of 45° S. fall into three groups—the Prince Edwards, the Crozets, and Kerguelen with Heard Island. For the first years of this century a vessel visited Kerguelen annually, otherwise visits to any of these outposts beyond Mauritius have over the last seven decades been few and far between, but the *Sule Skaer* went round them all a few years ago.

Most of these islands belong to the Sub-Antarctic and lie in the path of the permanent westerly winds. Amsterdam and St. Paul, on the other hand, are situated in the temperate zone and a region of constant high atmospheric pressure. It is therefore advisable from the outset to differentiate sharply between the islands south and north of 45° S.

Prince Edward Group, the Crozets, and Kerguelen

These islands of the Sub-Antarctic fringe lie 500 miles south of the nearest steamship route, and that the relatively unimportant eastbound-only track between South Africa and Australia. Only on the rarest of occasions does any ship to-day approach closer than this, but it was not always so. These islands have actually receded from our ken. The west wind of the " Roaring Forties " is the most regular on earth and accompanied by a strong current welling up from the Antarctic beyond Cape Horn. Consequently the outward sailing ship route of last century was carried further south than the present steamship lane, and then, of course, it was the only route to Australia. Steam and the Suez Canal have between them emptied these latitudes of shipping. This forms, however, only part of the story, as for several decades about 1855 the islands themselves were constantly visited. They were then centres of the Antarctic sealing industry, and in 1843 no less than 500 sealers were based on Kerguelen. The industry, however, proved short-lived, and since then the islands have reverted into oblivion.

The three groups owe their discovery to one of two simultaneous attempts to locate the Great Southern Continent which in the eighteenth century was believed to lie beyond the most southerly known land. The French searched the Indian Ocean and so discovered these lonely islands in 1772. The British under Captain Cook first examined the Pacific, but Cook proceeded to the Indian Ocean four years later and rediscovered them without knowing the French had already been there. It was he, however, who made the first landings,

for the non-British navigators of this period all seem to have been rather averse to stepping ashore in the lands they discovered.

Before passing on to describe my visit in the *Sule Skaer*, something must be said about the climate of these Sub-Antarctic islands. The controlling factor is always that saturated westerly wind which here whistles round the world regardless of season and is so strong that even the westbound Australia–Cape steamships keep well north of the eastbound track in order to escape its influence. Occasional calms do occur, but most days of the year, summer and winter, the wind blows with gale force. Constant wind from the westward and constant damp mark these regions of the " Roaring Forties." The mean annual cloudiness is 65-70 per cent., much the same as north-west Scotland, but near land the percentage is even higher. Cloud is more evenly distributed throughout the year than over the least favoured parts of Britain, and so sunny days are even rarer. The tops of the islands are hardly ever free from mist. Hardly a day passes without rain, whilst heavy snow may fall at any season. The mean temperature is much lower than in equivalent northern latitudes. Kerguelen is slightly nearer the Equator than Cornwall, but belongs to quite a different world. In the Southern Hemisphere the distribution of land and sea has almost eliminated the cool temperate zone, and these islands have an average temperature during the warmest month of only about 45° F. with some ten degrees less in winter. They are spared the severe winters of Newfoundland or Iceland, but also lack their warm summers. And the raw westerly gale, usually with some north in it, blows day-in and day-out ! Summer is perhaps best likened to early autumn in Southern Iceland and winter to late autumn. In terms of human habitability the advantage lies with Iceland, where not only do the calm, warm, summer days give a respite, but extensive plains near sea-level provide a living space which possesses no equivalent in these Sub-Antarctic islands. All lie well within the northern limit of drift ice, and short of Antarctica itself there are no less attractive lands.

The *Sule Skaer* left the Cape in September, the equivalent of the northern April, and first called at Marion Island, the larger of the Prince Edward Group and 12 miles long by 7. Its peak is over 4000 feet high, but snow came down to under 1000 feet and shrouded in cloud practically everything above the snow-line. We steamed around Marion and then proceeded 12 miles north-east to its smaller neighbour, Prince Edward, of less than half the height. There are few practicable landing places on either, and the summit of Marion at least is under permanent snow. Both islands are treeless and lack even a bush. Their surface is bare rock strewn with boulders, alternating with expanses of bog and rank moss. The rock is basalt everywhere. This group seems to have no history beyond its discovery and has been less popular with the sealers than the islands further east.

Continuing Australia-wards the *Sule Skaer* made for the Crozets, a series of half a dozen islands scattered over several degrees of longitude. Sailing astern and constantly dipping into the ship's wake was the prolific bird life of the Great Southern Ocean—hundreds of albatrosses, Cape petrels, Mother Carey's chickens, etc. The weather turned bitterly cold. First came rain, then snow, and finally fog descended. To have closed the Crozets under such conditions would have been sheer madness and so we sheered off to the north, waiting for the fog to lift. After two days the visibility showed no signs of improvement and there remained no alternative to missing the Crozets and proceeding to Kerguelen.

The Crozets resemble the Prince Edward Group in every respect. The two largest, Possession and Hog, are about the size of Marion and Prince Edward respectively. Sea-elephants and sea birds frequent them during the breeding season, but pigs let loose on Hog Island have disappeared. The group was much used by the old sealers, and one of their men lived on Hog for several years in the 1870's. About that time, too, small provision depots were established by Great Britain for the benefit of shipwrecked seamen. Shortly afterwards a French sealing vessel, the *Tamaris*, was lost on Hog, and after her crew had eaten

out the local provision depot they set sail in their surviving boat for Possession, but were never heard of again. The story of the wreck was learned a few weeks later from a message tied round the neck of an albatross which was picked up dead on the beach at Fremantle, Western Australia. (It looks as though even the albatrosses of these latitudes observe the " eastbound traffic only " rule !) As a sequel the French Government, which always claimed jurisdiction over the islands in this sector, in 1887 set up larger provision and clothing depots all along the *Sule Skaer's* route (including St. Paul), but their purpose had already almost passed. Sealing had ceased, and the sailing ships which might have been blown so far off their course were approaching the end of their era. The stocks have not been inspected since they were put ashore and all must have completely rotted away by now. Rabbits, however, were introduced into all the islands

long ago and have multiplied to such an extent that no castaway need fear starvation.

The fog lifted as we left the Crozets behind and we arrived off the north-west corner of Kerguelen to find its snow-covered peaks glistening in sunshine. We had been lucky enough to strike one of the few fine calm days of the year.

Kerguelen is extensive, measuring 80 miles by 70, but land and sea are so intermingled that it has an area of only 1400 square miles, equivalent to the six Scottish south-eastern counties less Berwickshire. The scenery is magnificent. Few coasts are more indented and no part of the island situated more than 12 miles from salt water. Many of the isthmuses are so narrow as to have gained the name of " overhauls " from the old sealers who preferred dragging their small boats across rather than sailing round. Plains at or near sea level occupy less than five per cent. of the total area. The western half of Kerguelen is the highest and the least known, much of it is covered by the Cook Glacier. They

are mainly in the "waist" of the island and the eastern part of the Courbet Peninsula. Most of Kerguelen is mountain, ridge, deep valley or plateau. The highest peak, Mt. Ross, reaches nearly 6500 feet and many are known to range over 2000 feet. Kerguelen's size and general appearance are such that, when discovered by the Breton seaman whose name it bears, he believed he at last found the missing Southern Continent. He at once returned to France with the news and came back the following year with two ships, but very quickly learned his mistake. In disgust he named the island "Terre Désolation," most appropriate in any case. Captain Cook arrived three or four years later, landed and gave it more attention than his predecessor. He named the leading features and, in particular, Royal Sound, a magnificent sheet of water in the south-east corner. Kerguelen was visited by several scientific expeditions last century, notably that of the *Challenger*. These and the sealers have spread over the chart a mixture of English and French place-names.

Ninety years back Kerguelen was the main centre of the southern sealing and shore-based whaling industry, but when this collapsed was deserted again. France formally annexed it in 1893, and the idea was entertained of making the island a penal settlement. The argument was that the climate would make the convicts work ! Eventually a Havre company was granted a 50-year lease for the exploitation of Kerguelen. The company did some sealing and built a small oil refinery for treating the blubber. Most of the staff was Norwegian. Then in 1908 twenty sheep were imported from Iceland and efforts made to make Kerguelen a French Falklands. Although suitable fodder was found, the attempt failed. Points overlooked were the lower temperature, the fact that the island is even wetter than the Falklands, and the much more limited area at low levels. Finally, Kerguelen's isolation rendered the cost of transport prohibitive, for the island is 2000 miles from the nearest port (East London) and lies on the route to nowhere. While the experiment lasted a few people lived on Kerguelen throughout the year, and as late as 1929 these numbered three men and one woman. The company also did some sealing and built a small oil refinery for treating the blubber.

The island is of essentially volcanic origin with basaltic lavas dominating. Hot springs occur in a few places. Some poor but easily worked coal seams occur between basalt and provided inferior fuel for the tiny steamship which the French company maintained, but no other sedimentary deposits have been found. The presence of coal proves the island to have once been forested and the climate to have deteriorated during geological time.

Half the interior lies under permanent snow and ice and a few of the glaciers reach down to the sea, although most appear to be receding. There are numerous waterfalls of great height and also lakes devoid of life of any kind. None of the peaks has been climbed. Next to nothing is really known about the interior for it has been little visited. Venturing inland is purposeless and the going extremely hard. Where free of snow and ice the surface is either bog or bare rock and great boulders have been carried down from higher levels. The rabbits have played havoc with the limited vegetation.

Kerguelen lacks indigenous land mammals and land birds, but seals and birds of the Antarctic Ocean flock to its shores to breed. It does, however, share with the Prince Edward and Crozet Groups a unique insect life and a peculiar flora. The insects are few in number, and almost all are incapable of flight. As for flora Kerguelen has nothing so big as a bush. Its outstanding species is the Kerguelen Cabbage (*Pringlea anti-scorbutica*), a member of the Cruciferae which in the absence of winged insects has adapted itself to wind pollenisation. This unique plant grows in clumps and reaches a height of about a foot. It ranges from the sea-shore to over 1000 feet up. The distinctive vegetation and insect life are of great antiquity and quite unlike anything in Africa or Australia.

The island is large and high enough to show climatic differences, and the lee side is less raw than the west coast, where the permanent snow-line is

perceptibly lower. The maximum and minimum temperatures recorded at sea-level are 70° F. and under 16° F., but generally the range is limited with a few days below freezing point in winter and an occasional snowfall during the finest month, December.

The *Sule Skaer* steamed along the north and east coasts and then entered Royal Sound, 200 square miles of open, sheltered water. To the west of the entrance stands Mt. Wyville-Thomson (3160 feet). Ten miles up, four small islands enclose Island Harbour, the most popular anchorage of the sealers. Many fiords branch off from the Sound, and we proceeded to the head of the longest that has been charted, 20 miles from the open sea. The shores were desolate and barren until the land behind rose and gave some protection from the wind. Then a sparse vegetation appeared and it improved as we went further inland. The upper reaches of the Sound were dotted with high, flat-topped islands, and these were much greener than the mainland owing to the absence of the destructive rabbit. Towards the top of the fiord precipitous cliffs usually shut out the view, but through gaps we caught glimpses of distant ice-peaks. When the *Sule Skaer* could go no further she anchored. A party went ashore and brought back supplies of the Kerguelen Cabbage, famous among the sealers for its antiscorbutic qualities and full of iron. It was cooked, eaten and found to have a taste compared with which spinach is positively insipid !

We left Royal Sound in the early afternoon and steamed forty miles along the steep south coast. The scenery became ever wilder. The shore presented an unbroken rampart, 200-300 feet high, capped by pinnacles and all under ice and snow. Inland, beyond the cliffs, ranged vast snowfields with behind them a chain of mountain peaks. The entire scene was white. After an hour snow began to fall and within a few minutes the ship was in a blinding snowstorm. The coastline became completely blotted out, but we had already seen enough to realise we had reached the " World's End ", the southern limit of what might by any stretch of imagination be termed human habitability.

South-east of Kerguelen in 55° S. are located Heard (25 miles by 8, and 6000 feet) and the neighbouring but insignificant McDonald Islands. They stand on the same submarine plateau as Kerguelen and were discovered by sealers ninety years ago. Heard is one vast glacier and its December temperature only 36°-39° F. There is no secure anchorage.

The Prince Edward Group, the Crozets and Kerguelen–Heard are all basalt formations from the same geological epoch. No connecting submarine ridge has been found, but they have clearly been linked at some time. The common and distinctive flora confirms the geology. It is clear that they have never been joined to Africa and the ocean depths to the south give no grounds for presuming an ancient link with the Antarctic Continent.

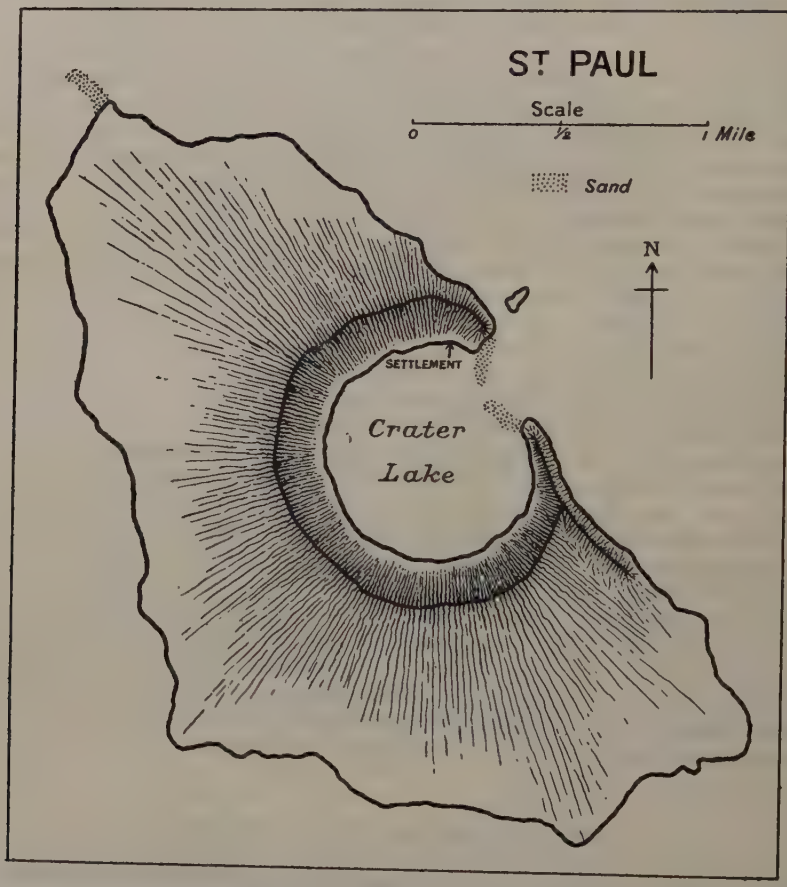
St. Paul and Amsterdam Islands

From Kerguelen's snow the *Sule Skaer* proceeded north-north-east to the warm temperate zone, from the Roaring Forties to the belt of highest atmospheric pressure in the Southern Hemisphere. The chill and rawness of the Sub-Antarctic were exchanged for a climate much the same as the Azores, since St. Paul and Amsterdam resemble the islands further south only in their remoteness from other land. The Cape–Australia steamship track misses them by many miles, but they used to lie so close to the sailing route to the Far East that the outward-bound China clippers made a point of sighting the peak of Amsterdam in order to verify their position. They were accidently discovered during the first voyage round the world, Magellan's in 1552.

The islands are of volcanic origin and rise from the same submarine base but 50 miles apart. St. Paul originated in Tertiary times, whilst Amsterdam dates back no further than middle Quaternary. The latter volcano is not yet quite extinct and its newer lava produces a more fertile soil than St. Paul. The

neighbouring banks teem with fish and are very occasionally visited by native fishermen from distant Réunion.

The *Sule Skaer* anchored off St. Paul early in the forenoon and we found the island to be a most striking formation—an ancient crater with the regular lines of a specimen model. The crater was as near a perfect circle as could ever be and the wall a steady 840-860 feet high for seven-eighths of its circumference. Part of the north-east sector had, however, been breached and allowed the ingress of the sea over a sill covered by seven feet of water at the highest tides. This direct entrance of the ocean is of relatively recent date, as 250 years ago a Dutchman, Vlaming, found a land barrier six feet high across the present opening. St. Paul is nothing but a crater wall, steep on the inside but sloping



down gently to sea-level on the north, west and south sides. The land area is only two and three-quarter square miles. The crater lake has a diameter of three-quarters of a mile with a depth of rather under 200 feet and, like the banks offshore, is alive with fish, particularly crayfish.

St. Paul is built of an extrusion of basalts, followed by lavas, scoria, palagonite tuffs and ashes capped by basalt flows from the crater. Old trachyte appears at one point. The soil contains much sulphur and is covered with tufts of coarse grass. The temperature is warm and equable with a moderate but adequate rainfall, although fresh water is liable to be short in summer.

The French made an abortive attempt at settlement in 1840. Thirty years later two Frenchmen lived on the island and employed themselves collecting fresh water for whalers. In 1928 the French Government again tried to settle St. Paul. The economic basis of the new settlement was to be the crayfish, and

so a small canning factory was erected. The tiny colony comprised twenty men and two women, but was soon torn by squabbles whilst remoteness rendered the crayfish canning unprofitable. It was therefore abandoned in 1931 and we were the first visitors to St. Paul since.

A party landed from the *Sule Skaer* and the ship's boat carried us across the sill into the crater lake. Half a dozen sea-elephants lay asleep on the sand spits as we passed through the entrance. We landed without difficulty at the canning company's pier a few yards to the right and found it in reasonable condition. Immediately ahead on a level stretch of ground stood the abandoned buildings—the derelict factory and a few wooden houses—all falling into decay. To one side was a heap of unused rusty tin cans. Normally the site of human habitation can be recognised decades after its abandonment by vegetable gardens run to seed, but there was nothing of this on St. Paul and its absence suggested that the settlers did very little " settling." Beyond the hutments there was no level ground anywhere. The land sloped uninterruptedly, but at a decreasing angle, from crater lip to the flooded floor, leaving no foreshore. Any paths that might once have existed had disappeared, but the incline was insufficiently steep to hamper movement, and the ground was firm in most places. At one point a hot spring bubbled freely at the end of the lagoon.

The topography of St. Paul was remarkable enough, but more remarkable still were its penguins. These belonged to the variety known as " rockhoppers " and had congregated in their thousands for breeding, but had not yet laid their eggs. The birds had three or four long yellow feathers protruding from the back of their heads and from a short distance looked like little old men wearing straw hats. Their rookeries took the form of strips 8-10 yards wide climbing from the lagoon right to the top of the island and were spaced at regular intervals all the way round the crater some 40 yards apart. Within them the black-and-white penguins were crowded so thickly as to give the crater wall a striped appearance akin to a peppermint " humbug." Each strip had its adjacent " bathing beach." The rockhoppers allowed us to walk among them exactly as we wished. A few hopped out of our way, but most did not trouble to move.

The largest rookery was sited near the lagoon entrance and differed from the remainder. It was the shape of an isoceles triangle with one side along the crater lip and its apex many yards short of the water. These penguins were unique in having established their bathing beach on what might be called " the ocean coast." The route between their colony and its beach crossed the shoulder of land formed where the crater edge descended to sea-level and along it the penguins had established two clearly defined roads from which they never wandered. One was for down-traffic and the other for up. Never did a penguin try to hop down the up-road or up the down ! The rockhoppers came down to the beach in companies about twenty strong, each with a most obvious non-commissioned officer leading the way. They hopped along the road at about a mile an hour with the companies stationed 40-50 yards apart. On the beach similar order prevailed. One company swam around catching its dinner, whilst a second wetted its toes at the water's edge and the next waited its turn where the rock met the shingle. The penguins were only allowed in the water a stipulated time and as soon as a new party reached the beach they climbed ashore, flapped their wings for half a minute to dry, formed up in line and then started their long hop home along the other road.

On the landing party's return the *Sule Skaer* up-anchored and moved over to Amsterdam. This island derives its name from the ship of Van Diemen, its second visitor. It measures $5\frac{1}{2}$ miles by $3\frac{3}{4}$, is nearly oval in shape, and its 3000-foot cinder cone is not quite dead. One side is steep and inaccessible, but the other has possibilities. The greater height causes Amsterdam to be better watered than St. Paul, and the soil is also more fertile. All but the steepest slopes are green and we could even see a few trees or large bushes. Moving about were the descendants of cattle which had been landed at some time or other and run wild. A Frenchman was marooned on Amsterdam in 1793-95, but

no attempt ever seems to have been made to settle this island. St. Paul and Amsterdam have been the scene of three important wrecks. The British frigate *Megaera* was lost on St. Paul in 1871 but her stores were saved and her four hundred men lived on the island for three months before being taken off. In 1889 the British barque *Holt Hill* was also wrecked there, but her crew had the luck to contact a passing ship only eight days later. Amsterdam's victim was the *Meridian*, in 1853, and her 105 passengers and crew endured much suffering before being rescued by an American whaler.

From Amsterdam the *Sule Skaer* made for the nearest inhabited land, Mauritius.

THE CONSERVATION OF CERTAIN GLENS IN SCOTLAND

By Allan Arthur, M.I.C.E., M.I.E.E.

Scottish scenery is unique and it is questionable if in any other equal area anywhere in the world such diverse and varying beauty, quickly changing colour, light and shade can be found. Scotland is the Mecca of the scenic painter, where in Skye, or in one of the other islands, in Ross-shire or Argyll, in Perthshire or Inverness, or in the northern counties of Sutherland and Caithness he will find an endless change of scene so fascinating to the artist.

In these days of commercialism it is a national necessity that large tracts of unspoiled natural beauty should be preserved for posterity, as is being done elsewhere on a large scale in the establishment of National Parks. If it is necessary to have green belts around our large cities, how much more important it is for spiritual uplift and for regeneration of jaded minds and bodies to have large areas preserved for the benefit and recreation of the masses who have been drawn into the cities.

It is true that there is little mechanical industry in the Highlands and that large areas are depopulated, but industrialism will never rehabilitate the Highlander, as only employment in conditions to which by nature he is adapted and to which through generations he has become accustomed will appeal to him. The industries in which he feels at home are fishing, farming, weaving, forestry, gamekeeping, crofting, providing for the tourist traffic, and similar open-air occupations, and these are just as real employment to him as is the employment of the industries in the cities and towns to those who reside there.

The aim of our planners should therefore be to develop the facilities for such employment in these spheres and to give the residents in these areas some of the amenities of the towns without their social and other disadvantages. Cheap electricity at rates which the Highlander can afford to pay is an absolute necessity for this development, but that is a totally different thing from the pious hope that cheap electricity will re-populate the Highlands. Charges for electric lighting and heating of a house and steading and a certain amount of motive power are far beyond a crofter's ability to pay for them.

The policy of the Hydro-Electric Board is largely based on Continental practice, where the conditions pertaining are totally different and therefore not comparable. In many regions on the Continent coal is scarce and costly as it has to be largely imported, and water-power resources are abundant and easily and economically developed and are naturally replenished from melting glaciers. It is not appreciated that the total projects of the Board, in a country which is rich in coal resources, could be produced more economically from less than 2 per cent. of the annual output of coal here. To produce this comparatively small total economically, of which the Highlands will absorb some 10 per cent. at most, it requires the construction of large and ugly dams and very costly aqueducts and the spoliation of many of our lovely glens, which will become

FALL OF
GLOMACH,
WESTER ROSS

THE DOG FALLS, GLEN AFFRIC

Photo by R. M. Adam

Photo by R. M. Adam.

FALLS OF BRUAR, STRUAN

RIVER GARRY,
PASS OF
KILLIECRANKIE

flooded areas in winter and objectionable and smelly mud flats and rocky river beds in dry summers. Anyone who knew lovely Loch Laggan and the Spean or Loch Treig before the hydro-electric developments in these districts has only got to re-visit them now to see what will happen to much of our glorious Scottish scenery if the Board proceeds with all its 102 schemes.

The Loch Sloy project has recently been the subject of a public inquiry, when it was recommended that the Constructional Scheme should be confirmed by the Secretary of State. This is now before Parliament for ratification. " Public interest," so often referred to in the White Paper, would appear to be the main reason for this recommendation, as the whole output of the scheme, 100 million units, is urgently required and is therefore of vital national importance, although the costs are extremely high. Without the original pumping features, which were abandoned before the inquiry, the same output could be obtained, probably eighteen months earlier and at about half the cost, from 45,000 tons of coal per annum—surely a moderate consumption. A further saving in transmission losses of approximately 20 per cent. would have been effected by the erection of a coal station near Glasgow, the receiving area. Due to natural geological conditions, the site of the power station had to be altered at the last minute. This is a distinct advantage, as the amenities of this lovely and world-famed district will not be impaired to any material extent, and there were, therefore, no objections.

Constructional Scheme No. 2 has just been issued for the Pitlochry project, which has also raised a great deal of controversy, not only in Pitlochry itself, which stands to lose much of its attraction as a tourist and health resort, but all over the country, as, once the damage is done, it can never be repaired. Many national and local interests will lodge objections to this scheme, and as these will be on amenity and technical, as well as on other grounds, and are not frivolous, a public inquiry will probably be held. Under Section 9 of the Act, the Board must, in the exercise of their functions, have regard to the desirability of preserving the beauty of the scenery, and must consult the Amenity and Fisheries Committees set up by the Act.

Then there is Glen Affric—to many the most lovely glen in all Scotland. Since 1941, when this glen was again in danger, public opinion against its spoliation has steadily grown and the slogan " Hands off Glen Affric " has been repeatedly used in the press. There is no compensation possible if " The Dog Falls " in this glen of unique beauty are once destroyed, as they undoubtedly will be if the Board is allowed to proceed with its development as planned there.

The Falls of Glomach (over 370 feet and the highest falls in Britain), which at present discharge into Little Loch Long on the West Coast, belong to The National Trust of Scotland, and as Kintail also has recently been acquired by the Trust the whole catchment area is now their property. The Falls can be approached from either end of the old " coffin " road, which is a right of way and runs from Carnach in Glen Elchaig, across the river just above the gorge, and then over the Bealach and down to Kintail at the head of Loch Duich. It was the intention of the promoters of the 1941 Bill to divert these waters into the Affric and down the Beauly to the East Coast and leave only bare rock and a gaping gorge where now there are these superb falls.

It probably would have been better had the Board proceeded with more moderate schemes, which would operate on the difference between the winter and summer levels of the lochs involved. This would have obviated the necessity of the construction of very large civil engineering works costing an enormous amount of public money and would have had insignificant effect on the amenities and beauties of the districts affected. There is no doubt that moderate schemes, which are much more suited in every way to our scenic and climatic conditions, can be made to pay, as many small projects of under 50 kilowatts are operating economically to-day in our Highland glens at well under ½d. per unit. These schemes, which could supply all the needs of the Highlands, could be constructed for a fraction of the cost of the very large schemes projected, and to

imagine that many of these will be " gold mines " is just wishful thinking unless the capital involved is simply written off and forgotten about, which is not sound economics.

The natural Highland water power is almost ideal, as in most cases it involves taking water from small streams at an altitude of several hundred feet without interfering with the watershed or the local amenities. These plants, not exceeding a few hundred horse-power and under local control, would offer advantages to the surrounding population obtainable in no other way, but these are almost specifically excluded from the project because they cannot be fed into the Grid and thus exported to the Forth and Clyde area and further south.

Large coal stations cost about half the amount of hydro-electric stations of similar output to construct, and as, with modern equipment, the unit of electricity (which is 1 kilowatt for an hour) can be produced for a little over 1 lb. of coal, the cost of the coal is a comparatively small item of the total. The thermal efficiency of a modern coal fired station is not much more than 28 per cent., or, put more clearly, almost three-quarters of the natural energy stored in the coal is at present lost, with results injurious to good health. Were these straight condensing stations run in conjunction with district heating schemes and process steam used, as it is in many large private plants in industrial and manufacturing concerns, the thermal efficiency would be more than doubled and the lost energy reduced to one-third. Against this economy no hydro-electric project in this country could possibly compete. It is questionable if it could even do so on the Continent where the capital charges per kilowatt are only a fraction of those pertaining here. Notwithstanding, district heating has been extensively developed in the U.S.A., on the Continent, and in the U.S.S.R. Electric heating, though very clean and convenient, is relatively expensive in this country, where there are still very large coalfields. Such combined power and district heating plants would assure a very great economy of our coal resources, and would eliminate almost entirely the domestic chimney, the chief cause operating against a clean and healthy environment in our large manufacturing districts.

In the Financial Statement issued by the Electricity Commissioners for 1936-37, it is stated that fully 80 per cent. of the gross surplus is for interest, loan repayment, and income tax, all financial charges. These same charges would apply to hydro-electric schemes but on double the capital. It is therefore true that in this country electricity can be produced much more economically from coal than from water power. There is the further disadvantage that with large hydro-electric schemes 15 to 20 per cent. is absorbed in transmission losses, while coal stations can be put down in or near the areas which they are to serve. With small individual hydro-electric schemes these long-distance transmission losses would not occur.

In certain districts, where small hydro-electric plants cannot be economically constructed, the crude oil engine is the cheapest form of power available at present, and with automatic development in these Diesel plants the results are very satisfactory.

It seems to me that in many cases amenity, for the benefit of the community as a whole, will be sacrificed unnecessarily and beyond repair.

The tourist traffic (many thousands of people visit Glen Affric annually), with all its complementary employment, will be greatly increased after the war and will be a source of much revenue to Inverness, and, if properly brought to the notice of the public, the natural attractions of the Highlands will be of much greater propaganda value than a dozen Loch Ness monsters.

The Scottish public are wakening up and beginning to realise that the natural resources of the Highlands are being commercialised without adequate or proper compensation to the people who now dwell there, and to those others who, it is hoped, will return in large numbers to their native heath in days to come.

THE FOUNDATION OF GRANTOWN-ON-SPEY, 1765

By Arthur Geddes

The foundation on Speyside in 1765 of a "burgh" no bigger than an English village, in order to encourage both agricultural marketing and handicrafts, is a fact of social history which calls for explanation. In particular, it may seem strange that at so late a date it should prove needful to found a burgh of medieval type. 1765 was the very year of the invention of the "Spinning Jenny." It was the dying year of a period when "manufacture" still meant handicraft, and the birth year of a new period when coal and steam engine, factory, ship and railroad were to create both the new freedom and the "wage-slavery" of the industrial town.

The access to England which came with the Union in 1707 and with peace after the 'Forty-Five, together with the early steps of the Agricultural Revolution in the Lowlands, combined to offer a readier market not only for the surplus cattle of the Highland pastures but also for other products. Hence, fifteen or twenty years after 1747, it became feasible for the more progressive of the larger landlords to encourage the marketing of stock and also to train the younger people, both men and women, to develop fresh skill in handicrafts, particularly as the all-round work of a Highland homestead makes for intelligent adaptability in the young. These crafts were principally those of "weaving, shewing and knitting." Thus, by some improvements in agriculture and by utilising the raw materials of the country, such as its wool, or materials imported from neighbouring Lowland tracts, such as flax, it was possible for a laird to increase both the well-being and numbers of his people and also the amount of his rentals. In order to do so by encouraging trade, it became necessary to found a privileged village for craftsmen and merchants (i.e. general shopkeepers), with a market place—that is, a "burgh." The foundation and regulation of such burghs was in direct line with early medieval tradition and with Scottish burghal law as we knew it back to the twelfth century. Let us trace an example of this development.

In Strath Spey the first attempt to found a burgh came in 1609, shortly after the Union of the Crowns. The object, as described in the Charter, was not only that the inhabitants should become richer and more "civilised," but that thefts and oppressions should be put down. The site suggested was Cromdale, on or near a moor of little value, some three miles down the Spey from the chief's Castle. But the times were still too unsettled, and owing to their poverty the Lowlands did not sufficiently attract trade. Moreover, traditions of anarchy were still unbroken among the wilder sort both of people and chiefs, not excluding the would-be founders of the Burgh! As late as 1699, ninety years after the first charter and five years after a second had been drawn up, a Laird of Grant raided the Tolbooth (or Townhouse and prison) of Banff, in an (unsuccessful) attempt to rescue one of his clansmen from the very hands of the Sheriff. This clansman, "Peter Brown," who was a favourite, being a fine fiddler and a man of spirit, was none the less an inveterate robber and an associate of the gypsy felon, James MacPherson, whose "bravoure" in the face of death was recalled by Burns in his song to the old chorus,

> Sae rantingly, sae dantingly,
> Sae wantonly gaed he;
> He played a spring and danced it roun'
> Beneath the Gallows tree.

Although MacPherson was hanged, Brown was reprieved by Grant's influence and died gallantly in battle under Argyle and Marlborough, in Flanders.[1] When the Laird, the civilising founder and hereditary dispenser of justice, was so lawless,

how were honest men, Highland or Lowland, to venture their goods in the Roughbounds? In 1694, it is true, a new charter had been obtained, and the little "town" or village beside the castle (henceforth called Castle Grant) was legally erected into a "free burgh of regality," though physically it remained unchanged. Power was given to hold courts of justice (under Grant or his Baillie), to buy and sell, to erect a Market Cross, a Tolbooth, and a jail (though seemingly the castle dungeons served for this), and to hold a weekly market and three fairs in the year.

It was not until seventy-one years later—twenty years after Culloden—that a new, and this time more ambitious and successful, attempt was made to found a burgh. The site chosen in 1765 was a mile from Castle Grant and the little old *Bail'a 'chaisteil* or Castletown beside it, which was soon afterwards cleared away, leaving an open green park around the Castle. The spacious green market-place or "Square" of the "New Burgh" was placed on rising ground from which the High Street led southwestwards. The following "advertisements" quoted by Sir William Fraser [2] explain the advantages of the situation.

"*Advertisement.*—On the Banks of Spey a little West of Castle Grant Sir Ludovick Grant and Mr. James Grant younger of Grant propose a TOWN should be erected and will give Feus or long leases, and all proper encouragement to Manufacturers, Tradesmen, or others, sufficiently recommended and attested, as to Character and Ability, who incline to settle there. The place proposed for the Town is called Feavoit, to which the Fairs and Markets in the neighbourhood can be collected. It will be the more convenient as it lies near to Spey bridge, has public roads branching off from it to Inverness, Nairn, Forres, Keith, Elgin, Braemar, Perth and to the W. Highlands, being eighteen miles Scots or 27 English miles from Inverness, and 12 [18] miles distant from Forres.

"Those who incline to settle, on Enquiry will find that it is a good pleasant Country, and well accommodated with all Materials for Building, lies near plenty of Moss (i.e. peat, and other Firing), has the pine Woods of Abernethie and Glenchernick near to it, and a fine limestone Quarry easily wrought. It will be particularly well situated for all manufacturers of Wool and Linen, being a great Sheep Country; the Linen Manufactury already introduced, the Soil good, and having fine Water and every Conveniency for Bleachfields. The situation is also well adapted for Wood merchants, Carpenters, Cartwrights, the Woods lying near, and to be had at low prices, and at a very moderate charge floated down the Spey to Garmouth, where shipping may be easily had. Besides what is to be feued or let on long leases, those settling at the above Place may have, in Tack, Cultivated or Improveable Grounds for their further accommodation.

"It is therefore desired, that any Person willing to take Feus or Leases, will give in their Proposals in Writing before the first of June 1765, to the Proprietors at Castle Grant or to Alex^{r}. Innes, Aberdeen, or Rob^{t}. Grant, Advocate, Edinburgh, as the Entry will be this Summer. There being some woods of Abernethie and Glencherick to be Manufactured this Year, those who want to purchase Planks, Deals, and Sparwood, will be served by applying to James Grant Inverury at Culnakyle, Overseer of the above Wood."

It will be noted, first, that the new "townsmen," after building their houses (or having had them built), are to be largely self-providing as to food and firing. In this again they are like the early Scottish burghers before the Wars of Independence, and the constant recurrence of warfare and sieges until 1746 had compressed their homes within a narrow circle of city walls.[3] The lands, tofts (crofts), or closes (enclosures) of old Edinburgh once helped to feed the craftsmen, much as a Lewis weaver's croft goes far to sustain, though not to enrich, him to-day. Second, the founder of the Burgh envisages the settlement not only of his clansmen but also of Lowland and other "Manufacturers," or business men, and craftsmen. Among these was the "Irish gentleman" who set up a bleachery and flax mill. Although most of the names on the early rent-rolls are those of Grants and other Speyside families, the native folk mingled with newcomers and inter-marriage followed. As to cultural influences, wealth and technique, backed

by the trends of the times, were on the newcomers' side, though Gaelic did not disappear until late in the nineteenth century and is still remembered in the country.

Three years later, a second advertisement reported some progress :

" In consequence of ane advertisement in 1764 notifying a town to be Erected in ane Improveable Moor near Castle Grant severall persons have taken off Tenements sites or holdings the most of which happens to be in the Square or Centre of the Town, and as there remains in the Square some very convenient and advantageous Tenements the Proprietor Mr Grant of Grant thinks it necessary to make the same publick, that Persons of Circumstance, Manufacturers or others able to build conform to what is already done may apply before they be otherwise Disposed off.

" The Advantages that might arise to Industrious people settled here in any kind of Business are too numerous to be hinted at in this." Besides the building stone and peat moss already cited, there are mentioned " . . . Slate quarries in different corners convenient enough, and the river Spey for floating their Timber to their very Door, Grass for Cattle and Horse in a very Extensive Inclosure above the Town. (Grass for Horse gratis while Building.) The farm of Kilutra to be Immediately Inclosed and Divided and the Moor mostly ploughed down (by the Laird's oxen) and to be limed Immediatly and Sett at ane easy rate (both for corn land and grazing). There is nine annual Mercats or Fairs holds at Grantown for Cattle, Horse, Sheep, Timbers, Wooll, Woollen Cloath, Linen Cloath, Yarn, etc. and a Weekly Mercat. It's Centricall for the South country, Badenoch, and Strathern Dealers or Drovers and for Dealers (whether Buyers or Sellars) in the Low Country. . . . The Mercats are and will be for sometime, Custome free. There is Established a good Schooll, for teaching Latin, English, writing, and arithmetick, and Book-keeping, and two weeman's school's for shewing and knitting of Stockings and a fine new Church to be built within the Town."

The form of the leases throws light on the aspect of the houses and the " industrious " purpose of the town and also on the attention paid to laws and social welfare. The lease-holder, A.B., " shall build regular and fronting the street with stone and lime walls and cover the roofs with slate and build the dykes round the gardens with stone five quarters high and shall keep the houses in proper . . . repair . . . A.B. shall keep the regulations of the Royal Burgh . . . under . . . penalties . . . by Baron Baillie of the town or bounds for the time . . . and shall always grind all their grindable corns, grain and malt at the mill of the Castle Grant, Craggan or Dellifour . . . and shall pay multures, knaveship and services thereto and shall furnish a man when required . . . by Justice for watching and guarding the fairs and town and keeping the peace and shall give suit and presence in the Baron Courts of Sir James Grant . . . and shall obey . . . all regulations made by the said baillies for the good and convenience of the town . . . neither shall brew nor sell ale nor spirit liquers without special liberty from Sir James Grant under penalty of £5 sterling . . . and pay all cess and taxation. . . . The possessers . . . shall always be of honest character and reputation and of decent or proper calling or trade whereby they can earn their bread, and shall be of good neighbourhood. . . ." [4]

Some years later Mrs. Grant, the " south country " wife of the minister of the parish of Laggan in Badenoch, wrote of Grantown in a letter published in her *Letters from the Mountains* (1785) : " Strathspey is quite a civilised country compared to this [Badenoch] and has a good neat village in it, where the father of the district has been cherishing some exotic manufactures which do not seem to find the soil congenial. In fact the Highlander never sits at ease at a loom. 'Tis like putting a deer to the plough." There was probably truth in the comment ; in the old days a smith's " stiddy " (or anvil) was a fit place for a man, but a loom was fitter for a woman. In the Isle of Lewis and Harris lads who turned from the fishing, after bad years " between the wars," to weaving complained of its

monotony: the whole-time weaver in the Isles is unmistakably different from crofter and fisherman in physique and general appearance.

Equally interesting is the comment made by a progressive laird from the Carse of Gowrie with reference to Highland chiefs or proprietors. From Knightsbridge, then "near London," George Dempster, M.P., wrote to Sir James Grant in 1786 that there is "good opportunity for helping improvements in the Highlands by roads and bridges, etc. and encouraging the building of towns with the usual privileges. But much depends on proprietors cooperating in these endeavours. . . . I am in some doubt if that will generally be the case and whether the proprietors are not better pleased with the influence they derive from preferring a feudal system entire than from the people being placed in a situation more favourable for independence of every kind than they now are. If so [we should] leave time." [2] The remark on "influence" is interesting. At the same time it should be noticed that though Sir James Grant was lessening his personal association with the people of his name, he was gradually doing away with intermediary chieftains who held their lands on a wadset, like the Grants of Tullochgorum, and was resuming direct proprietorship as an active "improving landlord."

Besides the Established Church, another place of worship arose, built by a few farmers and "townsmen" for James MacIntosh, who was succeeded by James Grant. MacIntosh was a man of indomitable energy and high character, and his successor ranks as the greatest but one of the Presbyterian hymn-writers of the Gael.[5] Later in life Grant was ordained a Baptist minister, but he remained a working farmer all his days. The spiritual history of the period from 1747 to 1850 has yet to be written, but one cannot but feel that relaxation of morals followed the disregard of what was literally, and in some sense truly, a larger brotherhood or family, the word "Clann" meaning children of a common ancestor. James Grant, as a young man, had reacted passionately from the "senseless gaiety" of weddings and wakes, no longer spiritualised and controlled by the earlier Gaelic faith, which held human intercourse and mutual service in the highest regard. The congregation he led built the church which stands back from the Square (on the N.W. side of it). Thus the outward order and progress of the little burgh hid difficulties of readjustment to a competitive, mercantile order, and some striving and unrest within.

From that time on, the people of Strathspey estate, including Grantown, have led a fairly continuous normal life. Although untroubled by evictions, they left in such numbers, as everywhere in the nearer Highlands, that there is little pressure on the land for its crofts and small farms. Forestry remains a steady industry, thanks in part to the natural regeneration of the pine, the badge of Clan Grant of old. Naturally, the growth of the factories in industrial towns checked the home industries of Grantown, and about 1815 trade was almost at a standstill and rents were in arrears. With the growth of the tourist industry, however, and the building of villas for strangers and returned emigrants, Grantown has grown, in summer population at least, and may be described as fairly prosperous. Moreover, for a place of its small size, Grantown's community life is varied and active.

REFERENCES

[1] The MacPherson episode forms a stirring tale, from which the writer improvised a one-act play, afterwards adapted for radio and broadcast in 1930.

[2] Fraser, (Sir) W. *The Chiefs of Grant.* 3 vols. Edinburgh, 1883.

[3] The towns of Flanders, portrayed by Bleau, show a great extent of garden, if not of corn lands, to every house, up to the anarchy culminating in the Thirty Years War.

[4] Noted in the Strathspey Estate Office, Grantown, from the lease of an ancestor of the writer.

[5] Macdougall, H. (Ed.) and A. and J. A. Grant. *Spiritual Songs of Peter Grant.* Glasgow, 1926.

[This article is an extract from the Newbigin Prize Essay, 1939, *Burghs of Laich and Brae.*—Ed.]

NOTES AND REFERENCES

EUROPE

BIBLIOGRAPHY OF THE PLACE-NAMES OF SCOTLAND. Printed sources of information anent the place-names of Scotland are widely scattered, many in the form of articles or notes in local periodicals. Much information, too, is concealed within books not dealing specifically with place-names. A bibliography of relevant books, pamphlets, and press cuttings, therefore, is essential to all who are interested in the subject. Such a bibliography has now been compiled by Mr. George Walker, Secretary of the Society, with the assistance of Dr. C. A. Malcolm, Mr. George Robertson, Dr. Angus Macdonald, Mr. John D. Gardner, and Mr. H. Marwick, for Mr. John Mathieson, Convener of the Place-Names of Scotland Committee. The bibliography, containing some 260 references, is classified in suitable sections, and has been mimeographed.

THE WATER RESOURCES OF LOCH QUOICH. The difficulty of basing an estimate of water resources on an insufficient number of rain-gauges, and the necessity for the recording of water levels, are pointed out by Capt. W. N. McLean in the *Quarterly Journal of the Royal Meteorological Society* (1914, 70 (*304*) : 138-140). Comparative rainfalls at Glenquoich and Glenshiel during 1936-1943 are tabulated.

HOUSE TRADITIONS IN THE OUTER HEBRIDES : THE BLACK HOUSE AND THE BEEHIVE HUT. By W. Kissling. *Man*, 1944, 44 (*114*) : 134-140. 7 figs.

COASTAL PRESERVATION AND PLANNING. A detailed survey of the 2751 miles coastline of England and Wales, excepting a few prohibited areas, has been made by the Ministry of Town and Country Planning. The results of this survey are described in *The Geographical Journal* (1944, 104 (*1-2*) : 7-18 ; 11 photographs ; 2 maps) by Mr. J. A. Steers, who personally inspected the whole coastline. The various parts of the coast were evaluated and classified according to the quality of their natural scenery, taking into account that of the immediate hinterland. Scenery of exceptional quality, such as parts of the Pembrokeshire and Devon coast, good natural scenery, as cliffs, dunes, salt marsh and estuary, and an intermediate category including coastal scenery of very good quality, as in Cornwall, and parts of the Norfolk and Yorkshire coast, are discussed and also shown on a map (1 : 500,000). Some of the finest parts of the coast are owned by the National Trust, but many have been spoilt by industrial undertakings, hideous settlements and by defence works. National planning is necessary to prevent further disfigurement and to improve access to the coast for walkers. Detailed measurements of the coastline by Dr. E. C. Willatts are given in an appendix to the paper. In the discussion, Professor A. G. Tansley suggested that the Lizard peninsula to the Helford River should be preserved as a national park. Dr. Dudley Stamp drew attention to the problem of directing the traffic so that enjoyment of the scenery will not destroy the very amenities which provide the enjoyment. The problem of architecture suited to the scenery was mentioned by Professor W. G. Holford, and Mr. J. Dower referred to future roads in relation to the coast.

THE EVOLUTION OF GUILDFORD. Guldeford in King Alfred's day, and inhabited by 175 men in 1086, is now the town of Guildford, extending to more than 7000 acres, and with a population of about 50,000. The history of its development and functions is reviewed by L. M. Budden in *Geography* (1944, 29 (*4*) : 114-122). The boundary of the town in 1739, the relief and present built-up areas, and the geology and old trackways are shown on maps.

THE STRATIGRAPHY OF THE CHALK OF SUSSEX. The result of a survey of the Chalk of the western area of Sussex between the Arun Gap to the Hampshire boundary is contained in the third part of a paper by C. T. A. Gaster (*Proceedings of the Geologists' Association*, 1944, 55 (*3*) : 173-188. 1 map), of which the first part (1937) dealt with the west central, and the second (1939) with the eastern area. The total thickness of the ten zones studied and mapped by the author is estimated to approximate 1330 feet.

THE PETSAMO REGION. The mineral resources, communications, inhabitants, and political importance of the Petsamo region are described in the *Geographical Review* (1944, 34 (*3*) : 405-417. 2 maps) by E. R. von Kuehnelt-Leddihn. No reference is made to the paper by T. W. Freeman and Mary M. Macdonald (*S.G.M.*, 1938, 54 (*4*) : 219-229), which deals, more fundamentally, with the physical features, climate, vegetation, and settlements.

GEOLOGY IN THE U.S.S.R. By V. Obruchev. *Canadian Geographical Journal*, 1944, 29 (*2*) : 76-79. 1 map.

ASIA

BRITISH RAILWAYS AND MOTOR ROADS IN THE MIDDLE EAST. The development by Great Britain of overland communications between the Mediterranean and India is described by M. B. Stratton in two articles (*Economic Geography*, 1944, 20 (*2*) : 116-129 ; (*3*) : 189-203. 7 figs.), the first dealing with steps taken during 1918-1930, and the second, with the Haifa-Baghdad and Haifa-Aqaba routes and with other projects in the " Middle " East between 1930 and 1940.

TRANSJORDAN : PAST, PRESENT, AND FUTURE. By B. Toukan. *Journal of the Royal Central Asian Society*, 1944, 31 (*3-4*) : 253-264.

WATER RESOURCES OF SAUDI ARABIA. Relief and water resources of the Nejd, Hejāz, Asīr, and Hasa are described by K. S. Twitchell in the *Geographical Review* (1944, 34 (*3*) : 365-386. 33 figs.). The author made extensive journeys in Saudi Arabia, and was leader of the United States Agricultural Mission in 1942.

IN SOUTH-WESTERN ARABIA IN WARTIME. In an address before the American Geographical Society (*Geographical Review*, 1944, 34 (*3*) : 349-364; 12 figs.) Miss Freya Stark described her travels in the Yemen which were undertaken, after the outbreak of war, to keep the Arab world of the south accurately informed. She went from Aden to the walled town of Ta'iz, the old provincial capital, and thence to Hodeida and San'a.

AN ARABIAN BIBLIOGRAPHY. By Lieut.-Col. G. De Gaury. *Journal of the Royal Central Asian Society*, 1944, 31 (*3-4*) : 315-320.

THE KURDS. The history, distribution, and activities of the Kurds, particularly of Iraq, are described by Major H. M. Burton in the *Journal of the Royal Central Asian Society* (1944, 31 (*1*) : 64-73). Objections to the formation of an independent state of Kurdistan are not merely political or economic, but can be based on the persistence of bitter intertribal feuds. "The development of communications and spread of education are the keys to the settlement of the Kurds as peaceful and law-abiding citizens."

MODERN COMMUNICATIONS IN IRAQ. By G. N. Loggin. *Journal of the Royal Central Asian Society*, 1944, 31 (*3-4*) : 302-305.

MUD VOLCANOES ON THE MAKRAN COAST. In various localities the accumulation of gases may give rise to volcanoes of watery or of viscous mud. Such mud volcanoes on the Persian and Baluchistan coast form the subject of a note in *The Geographical Journal* (103 (*4*) : 180-181) which is illustrated by photographs, by Squadron-Leader A. J. Young, of Chandragup, a mud volcano previously mentioned by Sir Aurel Stein, and of the Bulbulak, Napag, and Thok mud volcanoes. The latter, some twelve miles south of Kalat, erupted during the Quetta earthquake of 1935. Unlike mud volcanoes elsewhere, as in Burma, Venezuela, and Trinidad, the Makran group shows no signs of oil.

A GEOGRAPHICAL INTRODUCTION TO THE HISTORY OF CENTRAL ASIA. By K. De B. Codrington. *Geographical Journal*, 1944, 104 (*1-2*) : 27-40. 14 photographs. 1 map.

SIAM AND JAPAN. By Sir J. Crosby. *United Empire*, 1944, 35 (*3*) : 68-72.

GIANT EARLY MAN FROM JAVA AND SOUTH CHINA. By F. Weidenreich. *Science*, 1944, 99 (*2581*) : 479-482.

EXPLORATION IN THE UPPER TUNG BASIN. Two young Frenchmen, André Guibaut and Louis Liotard, explored the Salween gorges in 1936-1937, and in 1940 undertook a second expedition to the Chinese-Tibetan borderland peopled by the Goloks and the Setas. One of the chief objectives was the study of the upper Tung basin, a river which is named Ma Chow, Takin Ho, Ta-tu Ho, Tung Ho, and Tung Kiang in different regions, and which is the chief tributary of the Min, flowing into the Yangtze Kiang. The journey began at Tatsienlu (Kangting), the capital of Sikang, on June 13, 1940. André Guibaut gives an account (*Geographical Review*, 1944, 34 (*3*) : 387-404. 11 figs.) of the undertaking which ended tragically, owing to the death of Liotard and a Chinese servant, and to the loss of the caravan, during an attack by bandits who lay in ambush, on a high pass from which the explorers had made observations of the Bayan Kara mountains. The survivors were received with much kindness at the Golok lamasery of Dekho. The absence of even the smallest scrap of paper prevented Guibaut from taking notes of the return route, which is inserted from memory in one of the maps illustrating his article. Fortunately, the scientific data, including Liotard's astronomical observations, were ultimately recovered by the Chinese authorities. The problem of the sources of the Tung could not be cleared up, but a considerable part of unknown country was photographed and a notable contribution to the hydrography of the Tung basin was made. The article also tends to disprove the rumoured existence of a peak higher than Mt. Everest. Panoramic views show the mountain ranges and the valley of the Lichu.

CHINA'S MINERAL WEALTH. By C. H. Behre, Jr., and Kung-Ping Wang. *Foreign Affairs*, 1944, 23 (*1*) : 130-139.

AFRICA

THE SUDAN : PAST, PRESENT, AND FUTURE. By Sir A. Gillan. *United Empire*, 1944, 35 (*4*) : 120-123.

ETHIOPIAN COMMERCE AND INDUSTRY. By A. D. Bethell. *United Empire*, 1944, 35 (*6*) : 199-204.

WEATHER AND VOLCANIC ACTIVITY ON KILIMANJARO. Interesting meteorological observations were made on Kilimanjaro by Lieut. P. C. Spink, R.N.V.R., who reached the summit on February 1, 1943, and found snow lying down to 14,000 feet (*Geographical Journal*, 1944, 103 (*5*) : 226-229; 5 photographs; 1 sketch map). The lowest ground temperature recorded was 20° F. at 16,300 feet, whereas the summit temperature was as high as 37° at 15.00 hours. On a second expedition, in July of the same year, Lieut. Spink made a survey of the Kibo crater, and demarcated the active areas in the S.W. and N.W. quadrants of the true crater or Ash Pit, in the north-westerly part of Kibo. The occurrence of numerous fumaroles and sulphur deposits was noted.

THE MINERAL RESOURCES OF TANGANYIKA TERRITORY. An important record of the salient facts at present known in regard to the mineral resources of Tanganyika Territory has been compiled jointly by Sir E. O. Teale, D.Sc., F.G.S., and F. Oates, M.B.E., B.Sc. Printed as *Bulletin No. 16* of the *Department of Lands and Mines* (*Geological Division*) by the Government Printer, Dar es Salaam (1943), this publication (pp. 192, 8 figs., 1 graph, 1 map) consists of three parts. The first deals with minerals at present being worked, and the second with minerals not at present being worked. In the third part, all aspects of the economic minerals dealt with are discussed with reference to their importance. Additional notes, and production figures, are appended. Numerous bibliographical references are cited. This bulletin has not yet been released for general publication.

SOILS IN RELATION TO NATIVE POPULATION IN WEST USAMBARA. By G. Milne. *Geography*, 1944, 29 (*4*) : 107-113. Sketch map. Diagram of major soil zones. 3 photographs.

ROAD PROGRAMME FOR NIGERIA. Under the Colonial Development and Welfare Act (1940) a grant has been made for the purpose of extending internal road communications in Nigeria, the scheme providing for the development of 48,275 miles of roads. A grid of trunk roads will consist of the two principal roads, from Lagos to Kano and from Port Harcourt to Potiskum and Nguru, crossed by a series of four roads running at fairly regular intervals from east to west. Secondary trunk roads will connect large towns with this system or with convenient ports or railway stations, while feeder roads will provide local communications. The programme is to be completed by 1958-59. (*African World*, 1944, 169 (*2197*) : 189.)

DRODSKY'S CAVE. A remarkable group of intercommunicating limestone caverns, claimed to have been discovered by Mr. M. Drodsky in 1932, is situated amid sand-dunes near the extinct Khnihabe river in Ngamiland. The cave was explored in 1943, and is described by E. J. Wayland in *The Geographical Journal* (1944, 103 (*5*) : 230-233). It is now quite dry, and none of the impressive stalactites and stalagmites is growing ; an indication of climatic change is also afforded by the horizontal fracture of many of the columns, due to their own weight and consequent upon a reduction in volume of the cave-earth during a dry period. No traces of human occupation were found, but the cave is still inhabited by leopards.

FLUORSPAR IN SOUTH AND SOUTH-WEST AFRICA. An important report on fluorspar deposits, issued by the Union Department of Mines, has been reviewed in the *Bulletin of the Imperial Institute* (1944, 42 (*2*) : 118-121). The principal deposits are located in the Transvaal.

AMERICA

THE ST. LAWRENCE–HAMILTON WATERSHED. By J. Stainer. *Canadian Geographical Journal*, 1944, 29 (*5*) : 246-251. 14 photographs, 1 map.

AGRICULTURE IN QUEBEC. Land suitable for farming in the Province of Quebec is distributed in the three natural geographical regions : the fertile St. Lawrence plain, the Appalachian plateau, and the Laurentian plateau. The history of agricultural development since farming was begun in New France in 1617 is described by the Premier of the Province, Hon. J. Adelard Godbout, in an illustrated article in the *Canadian Geographical Journal* (1944, 28 (*4*) : 157-180). This valuable survey also includes a review of the Quebec farmers' war effort, with relevant statistics. A special committee recently reported on post-war problems and recommended a soil conservation and restoration policy, the maintenance of mixed farming, the development of agricultural industries, intensified research, better rural education, and social facilities. " Despite changes in methods of production, the Quebec farm must remain a family undertaking, a *bien de famille*. It must not become a ' factory ' exactly like a thousand others, a mere money-making device. It must be a living part of a living community."

FORESTRY IN QUEBEC : PAST—PRESENT—FUTURE. By A. Bédard. *Canadian Geographical Journal*, 1944, 28 (*6*) : 258-280. 18 photographs. Sketch map.

DECIDUOUS FOREST MAN AND THE GRASSLAND FAUNA. The interactions of the animals, plants, habitat, and settlers in the grasslands of central United States and Canada are discussed by Professor V. E. Shelford, of the University of Illinois (*Science*, 1944, 100 (*2590-2591*) : 135-140 ; 160-162), with special reference to the problem of overgrazing and erosion. He considers that public ownership of tracts in the great plains is necessary for the continuous study of grassland problems which forms an essential part of any national conservation programme.

INDIANS OF THE WESTERN PLAINS. The history and customs of the Indian tribes of the Plains are vividly portrayed in an article by M. W. Stirling, Chief of the Bureau of American Ethnology, in the *National Geographic Magazine* (1944, 86 (*1*) : 73-108. 30 illustrations).

SNOW MELTING AND EVAPORATION. Melting and evaporation rates, measured during winter and spring at elevations of 8700-10,000 feet on the Wasatch Plateau in central Utah, are discussed by A. R. Croft in *Science* (1944, 100 (*2591*) : 169-170). The studies have a direct bearing on irrigation and power problems in the adjacent valleys during the remainder of the year.

THE STRUCTURE OF BERMUDA. Observations on the structure of Bermuda, by W. Livingston (*Geographical Journal*, 1944, 104 (*1-2*) : 40-48. 9 figs.), tend to support conclusions by the late Dr. R. W. Sayles (1931) as to repeated rise and fall of the sea-level during glacial and inter-glacial periods. The islands all lie along the edge of a submarine platform, and they would

form one continuous piece of land were sea-level to fall by twenty feet. The sands and limestones and their succession are of considerable interest. Fossil trees and remains of birds confirm the past occurrence of oscillations of the sea-level; fossil birds' eggs were found embedded in firm limestone.

COTTON IN THE ECONOMY OF MEXICO. By L. A. Garloch, *Economic Geography*, 1944, 20 (*1*) : 70-77. 2 figs.

THE LAGUNA REGION. More than half of the Mexican cotton is produced in the Laguna Region, a basin extending over one and a quarter million acres and at an altitude of not less than 3700 feet above sea-level. The development and agriculture of this part of north central Mexico form the subjects of two articles by L. A. Garloch (*Economic Geography*, 1944, 20 (*3*) : 221-227; 20 (*4*) : 296-304). Both articles are illustrated by photographs, and the second one by maps showing the irrigation system.

CINCHONA PLANTATIONS IN AMERICA. In 1921 cinchona seeds obtained in Java were planted in Mindanao, and quinine production in Manila was well established before the outbreak of war. According to an article in *Commercial America* (1944, 40 (*10*) : 13), some two million seeds were taken to Australia on one of the last planes to leave the Philippines and ultimately reached Glen Dale, Maryland, where the plants were raised. Seedlings were distributed from there to a number of Central and South American countries, where permanent plantations have been established.

THE DUTCH WEST INDIES IN PEACE AND WAR. The distribution of the population and the development of Surinam and of the islands (St. Martin, St. Eustatius, Saba, Curaçao, Aruba, and Bonaire) known as the Territory of Curaçao are described by A. Muhlenfeld in *International Affairs* (1944, 20 (*1*) : 81-93). In spite of racial and religious diversity of the population within these scattered territories, there is an underlying unity of interests and outlook, which has been stimulated in the present century to a considerable extent by the opening of the Panama Canal and by the impact of war.

BABASSU NUT. A potential source of wealth, perhaps greater than that of the coffee crop, is the wild nut palm *Orbignya speciosa* which grows in the lower Amazon Basin south of Pará. The trees, which may reach a height of seventy feet, each yield annually some 5000 oil-producing nuts. The geographical distribution of these palms in relation to climate and soil, and the utilisation of every part of the tree, are discussed by A. G. E. Simmons in *Economic Geography* (1943, 19 (3) : 279-282. 5 figs.). Modern oil-crushing mills have been established in Pará and Therezina in addition to others. In 1941 production of kernels and oils had reached about 50,000 tons.

AUSTRALASIA

AUSTRALIA'S MINERAL INDUSTRY IN THE PRESENT WAR. Information concerning the mineral resources of Australia is scattered, and whereas the Mines Departments of the States are in possession of valuable data, the absence of a national geological survey has had a retarding influence on Commonwealth production programmes. However, a Minerals Production and Minerals Committee is making a valuable contribution towards integration of such information. The mineral resources of the Commonwealth are ably reviewed by H. G. Raggatt in the *Journal and Proceedings of the Royal Society of New South Wales for 1943* (1944, 77 (*2*) : 52-84. 16 figs.). In addition to graphs showing mineral production, the paper contains many clear sketch-maps.

AUSTRALIA'S DEBT TO FLINDERS. The voyages and discoveries of Captain Matthew Flinders have been reviewed in an address by R. G. Gillies, President of the Royal Geographical Society of Australasia (*Queensland Geographical Journal*, 1943-1944, 48 : 14-20), who reminded his audience that Flinders was the first circumnavigator of Australia and was responsible for the naming of the continent. Hydrographic work by Flinders was so accurate that portions of his charts are still used in coastal navigation.

THE GREGORY BROTHERS. The work of Augustus Charles Gregory and his brothers, F. T. and H. C. Gregory, is reviewed by A. H. Knight in the *Queensland Geographical Journal* (1943-1944, 48 : 53-59). In 1846 and 1848 their expeditions into the interior of Western Australia were responsible for the discovery of valuable grasslands and minerals as well as for the mapping of much unknown territory. The expedition, which proved to be of the greatest importance to Australian colonisation, was undertaken in 1855-1856 from Moreton Bay to the fringe of the Great Australian Desert. A. C. Gregory discovered the last authentic trace of Leichhardt at the Elsey River, and later led another expedition in a vain search for the missing explorer. In 1861 F. T. Gregory was in charge of the North-West Australian Exploring Expedition which discovered and named the Ashburton River.

WHAKATANE DISTRICT AND WHALE ISLAND. In notes on the geology of the region extending along the Bay of Plenty between Matata and Whakatane to Mount Edgecumbe, the physiography of the district is outlined by E. O. Macpherson (*New Zealand Journal of Science*, 1944, 26B (*2*) : 66-76), with special reference to thermal activity. A description of Whale Island (354 acres), a rugged feature composed mainly of andesitic rocks eight miles northward from Whakatane, is illustrated by photographs and a geological sketch-map.

THE GEOGRAPHY OF EXTENSIVE PASTORALISM IN NEW ZEALAND. The South Island high country on the leeward flank of the Southern Alps carries some 2,000,000 fine wool and store sheep. The area is leased in large blocks or pastoral " runs " to graziers, but the farming

methods employed have led to a considerable deterioration. With the object of assessing the future of these tussock grass lands, a detailed study of the topography, soil and climatic conditions, and economy of the Grasmere-Cora Lyn Run, adjacent to Arthur's Pass National Park, has been undertaken by K. B. CUMBERLAND (*Economic Geography*, 1944, 20 (*3*) : 204-220. 13 figs.). The major vegetation changes (1850-1944) are discussed and shown on maps.

POLAR REGIONS

THE ARCTIC INSTITUTE OF NORTH AMERICA. Interest in the Arctic and Subarctic regions of North America, stimulated in recent years by the building of the Alaska Highway and by the discovery and exploitation of mineral resources, has emphasised the need for co-ordinated study of these regions as a basis for planning their future development. While the Scandinavian countries and the U.S.S.R. have for many years been conducting systematic research on Arctic problems, North America has only recently taken steps to organise such activities. In May 1944 a group of prominent Canadians and Americans interested in Arctic problems met in New York in order to outline the project of an Arctic Institute of North America. A small committee was appointed to prepare a statement and to draft a constitution, both being formally approved at a second meeting, held in September 1944, in Montreal (M. BRIDGE, *Canadian Geographical Journal*, 29 (*6*) : 275-277). The first Board of Governors of the new organisation includes the Commissioner of the Northwest Territories, the General Manager of the Hudson Bay Company, the Chief of the Alaska Division of the U.S. Geological Survey, the Director of the Institute of Current World Affairs (New York), Dr. V. Stefansson, and other prominent North Americans.

The international character of the Institute is of particular value, since the basic problems to be solved are common to the entire region between Alaska and Greenland. It is expected that the necessary funds will be obtained to enable active work to start at Montreal by the autumn of 1945. Initial expenses are being defrayed by the National Research Councils of Canada and the United States, but when established the Institute will be privately financed and be a private organisation ; close co-operation will necessarily be maintained with the appropriate governmental agencies. There will, at first, be a small administrative staff, headed by a noted scientist with Arctic experience, and qualified investigators will be asked to apply for grants in support of specific research projects. The Institute will arrange for the publication of reports, maps, charts, etc., as well as for studies on scientific, social, and administrative problems. The research programme will include general and specific studies, and also a study of the relation of the Arctic regions to world problems. This naturally involves the development of an important library. Thus the Arctic Institute of America will be making a significant contribution to science, practical affairs, and international good will.

GEOMORPHOLOGY

GEOSYNCLINES IN CONTINENTAL DEVELOPMENT. By MARSHALL KAY. *Science*, 1944, 99 (*2580*) : 461-462.

DIFFERENTIAL MOVEMENT OF POINTS ON THE EARTH'S SURFACE. In an address to the New York Academy of Sciences (*Science*, 1944, 100 (*2588*) : 87-93 ; (*2589*) : 113-117), Dr. H. T. STETSON, of the Cosmic Terrestrial Research Laboratory, Needham, Mass., discussed modern evidence for variations in latitude and longitude of certain points, with reference to American and other observations, and to methods employed. Attention is drawn to correlation between movements of the earth's crust and rift-zones in continental shield areas, and also to the gravitational force exerted by the moon. An investigation, undertaken by Dr. Stetson some years ago, of the frequencies of the occurrence of major seismic disturbances indicated that, if through accumulated stresses earthquakes are about to occur, the occurrence is more likely during the time of maximal exertion of the horizontal tidal component of the moon's gravitational force.

DETERMINATION OF GEOGRAPHIC CO-ORDINATES IN GREENLAND. Observations to determine longitude at stations in eastern and western coastal areas in Greenland would seem to indicate progressive movement westward. The degree of reliability of these data, however, particularly of those relating to Sabine Island and Kornok (Oornoq), has been critically examined by C. R. LONGWELL (*Science*, 1944, 100 (*2601*) : 403-404). Longitude values determined by using modern radio time signals have tended to minimise or annul evidence of shifting position at Kornok, and it would seem desirable to check the co-ordinates at Sabine Island by the same methods.

HYPOTHESIS OF SUBGLACIAL EROSION. In an article in *The Journal of Geology* (1944, 52 (*3*) : 184-190) C. D. HOLMES suggests that ice at the base of thick glaciers is too plastic to remove underlying rock material by a plucking action, and that subglacial block disruption may be due to pressure-controlled freezing of melt-water in joints beneath the ice. Pressure and temperature variations in basal ice, the descent of melt-water, and their effects are discussed. The formation of roches moutonnées and of clastic dikes is examined in the light of this hypothesis.

BIOGEOGRAPHY

LIVING FOSSILS is the title of an article by Dr. D. H. CAMPBELL (*Science*, 1944, 100 (*2592*) : 179-181), in which are discussed the persistence of plant forms from the Palaeozoic era onwards and the relation of fossil to existing species. The existence of the same forms, either as fossils or

living species, in widely separated regions (as in Brazil and Equatorial West Africa, or New Zealand, Tasmania, and Southern Chile, or of *Araucaria* in South America and Australia), is adduced as evidence in support of A. L. Du Toit's theory of continental drift.

CARTOGRAPHY

GRID NAVIGATION. By superimposing a rectangular grid system on a non-Mercator chart, straight-line navigation on any conformal or approximately conformal projection is rendered possible. The adaptation of existing charts to grid navigation, especially of aircraft, the choice of suitable projections, and methods of grid navigation are examined in detail in a paper by S. Herrick (*Geographical Review*, 1944, 34 (*3*) : 436-456. 9 figs.). In grid navigation, grid variation, i.e. the angle between the magnetic meridian and a grid meridian, replaces magnetic variation and is applied by the same rules. Practical implications are fully discussed. Lines of equal magnetic variation (isogonic lines) and lines of equal grid variation (isogrivs) for Europe, the United States, and Arctic Regions are figured. Other diagrams illustrate lines of equal convergence (angle between the true meridian and grid meridians), comparison of scale along standard parallels of different projections, and the determination of a radio bearing.

A NEW MAP OF GERMANY. A *Map of Germany and Its Approaches* was published by the National Geographic Society, Washington, D.C., in July 1944. This map (33½ by 26½ inches ; 31.57 miles to one inch) includes the area between Copenhagen and Milan, and between Le Havre and Belgrade. It contains 8286 place-names, and particular attention is paid to the network of highways, railways, and canals. Printed in ten colours, this is the eleventh of the maps of Europe issued by the National Geographic Society since August 1914. These maps, and spellings of place-names, are reviewed by G. Grosvenor, President of the N.G.S., in *The National Geographic Magazine* (1944, 86 (*1*) : 66-72).

A COAL-MINING INTENSITY MAP. While the extent of coal-bearing formations within a region is commonly shown on maps, the mapping of production has been somewhat neglected. A new production map of the Appalachian bituminous coal region has been presented by Professor R. E. Murphy and Mr. H. E. Spittal, of The Pennsylvania State College, in *Annals of the Association of American Geographers* (1944, 34 (*3*) : 164-172. 3 figs.). As actual tonnage figures tend to be misleading, intensity of production is represented as a tons-per-square-mile ratio. The pattern of production intensity revealed in the map suggests the need for a series of maps based on production data in former years, in order to reduce any changes in the pattern to definite, measurable terms, and to obtain some information on production trends.

REVIEWS OF BOOKS

EUROPE

The Irish in Scotland (1798-1845). By James Edmund Handley. Demy 8vo. Pp. ix+313+xix. Cork : University Press, 1943. *Price* 10*s.* 6*d.*

The Irish harvesters, who used to make an autumn migration in great numbers before reapers and binders were invented, may still be remembered by many old farmers. They were the last evidence of the long story with which this book deals. Irish navvies still come when large constructional works are on hand, but happily the days of organised hostility, of resentment, riot, and broken heads have passed.

In these days it is difficult to realise the length to which the Protestants of Scotland went in their efforts to drive the Roman Catholics of Ireland from this country. This book tells the story. It is very fully documented, quotes at length from Government papers, and fastens upon the Scottish Ministers of the Gospel as the leaders who stoked the fires of resentment, wrote the innumerable pamphlets scattered through the land, and preached denunciatory sermons from their pulpits. None the less, a large settlement of Irish took root in Wigtownshire with a priest in residence, and, when works such as the Caledonian Canal, the Crinan Canal, the Forth and Clyde Canal, the Caledonian and North British Railways, the iron and coal industries of Lanarkshire were in progress, there was room enough for thousands of Irish of whom it was said that the laws and restrictions of their own land gave them a home in every country but their own.

A condition is commonly made, when large constructional works are in contemplation, that the labour will be recruited from Scotland—the Caledonian Canal is reported to have been agreed upon in order to give work to the Highlanders—but we have seen the native navvy fail to such a degree that the Irishman was welcomed. But we do not now have the wives and families of the navvies coming over in a state of destitution and causing serious embarrassment in the social and economic conditions of rural and municipal districts.

The comments of the author, without being other than evidential, are mildly favourable to the Irish side of the story.

W. L. C.

British Woodland Trees. By H. L. Edlin. Demy 8vo. Pp. ix+182. 133 illustrations. London : B. T. Batsford Ltd., 1944. *Price* 12*s.* 6*d.*

" This work has mainly been concerned with the identification of trees at all stages, and with the essential facts governing their growth and utilisation ; it deals only with the trees of one

country. The study of trees leads on into broader fields, into other lands, back into history, and on into the future. It reaches wide as the world and longer than the life of man."

In these words Mr. Edlin concludes his masterly narrative on British Woodland Trees, their properties and uses. Though designed in particular for foresters and woodmen, this book will be of immense value to a much wider public, for it deals not only with the culture and identification of trees (and incidentally with the names by which they are known in several languages) but with their commercial aspect and the properties and value of their timber ; the adaptability of the different species to light and shade and other matters of interest to urban as well as rural dwellers. An appendix contains valuable keys by which trees can be identified at all seasons, by buds and twigs, bark, fruit and seeds, etc. The layman will welcome the author's plea for the retention of the " equally correct and older name " of fir for the Scots pine (*Pinus sylvestris*), for he has always called it so, and apparently, as appears from Mr. Edlin's researches into the origin of the name, correctly.

In a Batsford book the reader expects beautiful illustrations, and is not disappointed in this charming volume, which is copiously illustrated not only by fine photographs but also from drawings and engravings. The frontispiece in colour is a representation of John Crome's serene " Poringland Oak " from the National Gallery of London.

This book supplies a want long felt by the ordinary tree-lover as well as by the specialist and scientist, and is to be warmly recommended also to geographers and all who love the study of the earth. I. W. H.

Brenva. By T. Graham Brown. Demy 8vo. Pp. xv+227. 72 photographs. 4 maps. London : J. M. Dent and Sons Ltd., 1944. *Price* 25*s*.

This book will be of greater interest to mountaineers than to members of the public who merely take an interest in mountaineering. It deals exclusively with the Italian face of Mont Blanc and Mont Blanc de Courmayeur, which falls to the Brenva Glacier. There is certainly no finer mountain face than this in the Alps. Prior to 1927 there was only one known climb on this face, a route made famous through " Running Water." Between that year and 1933 Professor Graham Brown made three new routes on the face : two guideless with F. S. Smythe, and the third with guides.

The whole subject is dealt with fully and the book is well written. The author avoids exaggeration of difficulties or dangers, but the reader realises from the reading of such a book the training and skill which are required to undertake such major climbs and the care which must be exercised in choosing the right times and routes so as to accomplish the ascents without undue risk.

The illustrations have been chosen with care and supplement the text exceptionally well.

A. H.

British Survey Handbooks. 2. *Rumania.* By C. Kormos. Fcap. 8vo. Pp. vii+122. Map. Cambridge : University Press, 1944. *Price* 3*s*.

The second of the *British Survey Handbooks* (cf. *S.G.M.*, 60 (*3*) : 87) deals with the background and vicissitudes of Romania [the more correct spelling recommended by the Permanent Committee on Geographical Names for British Official Use.—Ed.]. As this booklet shows, the people are mostly peasants accustomed to serfdom and oppression. Their country has been handed about in large part—Bessarabia and Southern Dobruja have passed from one power to another and sometimes back again. But the background, the essential character and customs of the people remain, and form the interesting subject of this handbook. W. L. C.

British Survey Handbooks. 3. *Greece.* Compiled by Kathleen Gibberd. Fcap. 8vo. Pp. vii+106. Map. Cambridge : University Press, 1944. *Price* 3*s*.

Information on the background essential to an appreciation of conditions and the impact of war in Greece (up to September 1944) is particularly welcome at the present time. The main physical features of the mainland and island regions are sketched in the first chapter of this little handbook. Of geographical interest, too, is the fourth chapter, on the daily life of the people, which deals with the Greek village, work on the land, the shepherds, the people of the islands, the women, rural industries and festivals, the towns, and traditional culture. Notes on local administration and health services are printed as an appendix. J. H. K.

The U.S.S.R. : An Economic and Social Survey. By S. P. Turin, D.Sc. (Econ.). Demy 8vo. Pp. xiii+219. 8 maps, 16 diagrams, 63 statistical tables. London : Methuen and Co. Ltd., 1944. *Price* 16*s*.

Before publication of this book, it was difficult to obtain up-to-date information on many aspects of the geography of the U.S.S.R. A serious gap in geographical literature has been partly filled by Dr. Turin, who includes social as well as economic conditions in his survey, so that his book is much more than an economic geography in the old sense of products, exports and imports.

An idea of the scope of the book can perhaps best be given by a brief résumé of its contents. Part I comprises a geographical and ethnographical survey. While most geographers would have welcomed a more elaborate account of the physical and climatic background of life in the U.S.S.R., those whose interests tend to the human side will appreciate the inclusion of a chapter on population, which, as well as dealing with changes and densities, throws light on occupational structure, proportion of rural and urban population, balance of births and deaths, ethnographical

structure, and religion. A constructively critical account is given of various means of communication, including a brief statistical account of air transport in the years preceding 1941.

Part II consists of summaries of the economic activities of the large number of regions in the U.S.S.R. The up-to-date figures for the populations of towns are especially useful, as with many rapid changes old figures may be quite misleading. In places this systematic factual material is lightened by brief references to historical circumstances and current changes.

In Part III, there are surveys of agriculture and industries, followed by a chapter on external trade showing how the policy of rational utilisation of natural resources has modified not only the character and volume of goods exported and imported but the geographical regions concerned. The agricultural chapter, especially, would have benefited by the inclusion of some distribution maps. A chapter on Trends in Economic Development deals critically with the main stages in economic policy since the Revolution and stresses the growing efficiency associated with the second Five Year Plan. The final chapter, In Place of a Conclusion, gives the author's opinion on the steps necessary to attainment of a higher general standard of living.

The value of the book as a work of reference is enhanced by Part IV, which, in addition to tables of exports and imports, comprises supplements giving information on scientific and technical research and libraries, model rules of the agricultural artel (the newer type of collective farm), the structure of Gosplan (State Planning Commission), the administrative, political, and territorial structures of the Union, population statistics, a list of cities with over 50,000 inhabitants, and a list of renamed towns.

This book is definitely a reference book for the more serious student of the U.S.S.R., and as such should prove very valuable. As the author points out in the preface, shortage of paper has necessitated compression, and although, as he admits, the style is not attractive, he has written "in a way which, according to the Russian saying, would provide plenty of space for thought, and very little for words." C. P. S.

ASIA

China. By A. G. Wenley and John A. Pope. Med. 8vo. Pp. v+85. 25 plates. 7 sketch maps. 3 figs. Smithsonian Institution War Background Studies No. 20. Washington, D.C.: Smithsonian Institution, 1944.

This number contains an excellent summary of the geographical features of China and of Chinese history old and new, also references to the language, art, philosophy, social organisation, and government. There are numerous good illustrations and some sketch maps and chronological tables.

The impression is given that Britain went to war with China to enforce the legalisation of the opium traffic, which is quite misleading. A recent book, *War and Politics in China* by Sir John Pratt, should be read by those wishing to dig up ancient history. W. O. L.

AUSTRALASIA

New Zealand: A Working Democracy. By Walter Nash. Demy 8vo. Pp. vii+290. Frontispiece. 1 map. London: J. M. Dent and Sons Ltd., 1944. *Price* 8*s.* 6*d.*

New Zealand: A Working Democracy. This is at once the title and the recurrent theme of Mr. Nash's book. Here we see New Zealand as a model democracy, which in a brief but eventful history has come as near to realising the ideal of social security as any other nation. What could be more fitting than that this testimony should come from a man who has played a leading part in making New Zealand what she is to-day.

It is firstly as a New Zealander and secondly as a Labour politician that Mr. Nash writes of the solid achievements of the present Labour Government, the magnificent war record of New Zealand's fighting men, and the measures taken within the Dominion to ensure that Britain's essential food supplies should not be diminished by the shortage of manpower in production. In the last part of the book Mr. Nash sets out his personal faith in a future of reconstruction on a world scale. There is nothing here that is markedly profound or original, but there is much good sense and sound reasoning, and one is heartened by the author's firm conviction that it lies within the power of the United Nations to frame a well-ordered peace for the betterment of the whole world.

The book lacks that simplicity of treatment which makes easy reading, but in place of this there is a purposefulness and a wholehearted enthusiasm which carries one through its pages. There is something here not only for the statesman and the political geographer but for all, and there must be many, who feel the need to know New Zealand better. A. P.

GEOMORPHOLOGY

Volcanoes as Landscape Forms. By C. A. Cotton. Demy 8vo. Pp. 416. Frontispiece. 223 figs. Christchurch, N.Z., and London: Whitcombe and Tombs Ltd., 1944. *Price* 32*s.* 6*d.*

This very fine work, notable not only in its subject matter but also for, in war-time, excellent printing and magnificent illustration on good glossy paper, is dedicated to F. A. Perrett and T. A. Jaggar, "volcanologists of this century," and is based largely on their work. The book is divided into two unequal parts: Part I, Introduction on the Mechanism of Volcanism (69 pp.), and Part II, Volcanic Landscapes (330 pp.). The first part, despite its brevity and its casual

dismissal by the author (in the Preface) as a "few brief introductory chapters," manages to include a concise but comprehensive discussion of modern theories of volcanic mechanism, which is worthy of being placed alongside of any other modern text on this topic.

The subject of the second part is one in which Prof. Cotton is a well-known master. It is treated in twelve chapters under the headings: Domes and Cones of Basaltic Lava; Lava Plateaux and Plains; Lava Fields; Aa and Block Lava, Scoria Mounds; Viscid Lavas, Coulees and Tholoids; Ash-showers and *nuées ardentes*; Ash-built and Stratified Cones; Maars and Tuff Rings, Meteor Craters; Submarine Eruptions, Pillow-Lavas; Craters and Calderas, Volcanic Depressions and Lakes; Dissected Basalt and Ignimbrite Plateaux, Basalt Plains; Erosion and Destruction of Volcanic Mountains. It is impossible to say more in a short review than that the above list illustrates the thoroughness of the discussion of volcanic forms, which has been carried through with all Prof. Cotton's skill in writing and illustration. Although the second part is devoted primarily to the morphology of volcanoes, the discussion of volcanological theory initiated in the first part is continued throughout. There is a brief appendix on "Volcanic Contributions to the Atmosphere and the Oceans."

The author expresses the hope that the book will find readers not only among specialists, but also among general readers interested in landscape forms. It will certainly find readers in this constituency; but the only criticism of the book that can be voiced by the reviewer is that such readers may be somewhat deterred by the superabundance of technical terms. G. W. T.

OCEANOGRAPHY

Pacific Ocean Handbook. By Eliot G. Mears. 7×4 inches. Pp. x+198. 58 figs. 7 maps. Stanford University, California: James Ladd Delkin, 1944. *Price* $2.00.

This handy little book, written, as the author states in his Foreword, "for the military forces and civilians alike," packs a solid store of information, general and particular, into its two hundred pages, interspersed with some sixty illustrations embracing sketches, maps, and photographs. Besides being most informative scientifically, there is abundant material of great interest to the traveller and also some very useful practical instructions obviously with a war background but none the less applicable, though we trust with much less frequency, in peace time.

There are chapters on the structure of the Pacific basin, on its numerous islands, on the physical conditions of its waters, their drifts and currents. Every aspect of Pacific climate is described, with particular attention to storms. Navigation, magnetism, and tides are other matters which are given due place and attention. The concluding part of the volume comprises a number of useful and interesting statistical appendices. J. B. T.

EDUCATIONAL

The British Isles: A School Certificate Geography. By S. J. B. Whybrow, B.Sc., F.R.G.S. Crown 8vo. Pp. x+196. 66 sketch maps. 20 photographs. London: J. M. Dent and Sons Ltd., 1944. *Price* 3*s.*

To those who are familiar with Mr. Whybrow's geography note-books, his emphasis on the importance of the sketch map is not surprising. His maps give merit to a book which might otherwise be described as "bitty." His treatment of the agricultural activities and general farming conditions is extremely good; there are few school text-books which deal so adequately with this important branch of the geography of the British Isles. On the other hand British, and particularly Scottish, industries and industrial development are treated in a much less masterly manner. Little attempt has been made to show the impact of foreign production on certain of the outstanding industries or even to indicate sources of raw material.

Mr. Whybrow mentions the fact that some geographers take the Jurassic scarplands as a division line between metropolitan and industrial England. This line also divides the book. Had the rest of the book been like the section on metropolitan England it would have been of outstanding merit. Nevertheless, Scottish geography teachers should certainly read it, but whether it would suit the requirements of most Scottish schools is another matter. A. T. G.

GENERAL

International River and Canal Transport. By Brig.-Gen. Sir Osborne Mance, K.B.E., C.B., C.M.G., D.S.O., assisted by J. E. Wheeler. Demy 8vo. Pp. viii+115. 2 maps. Issued under the auspices of the Royal Institute of International Affairs. London: Oxford University Press, 1944. *Price* 10*s.* 6*d.*

While not for the general reader, this book is a most valuable contribution to the study of transport by inland waterways. It deals almost entirely with the administration of rivers and canals which pass through more than one country—such as the Rhine and the Danube—indeed, almost half the book is taken up with the canal and river systems connected with these two rivers. There is no mention of canals such as the Suez, Panama, and Welland and the canals in Britain—none of which fall within the scope of the survey.

The book makes it clear that prior to the present war, navigation on inland waterways was very far from being open to all shipping, for which there were substantial reasons. Complications arise such as the competition between ports, State subsidies, the rationalisation of inland shipping, the entry of ocean vessels, and various political motives. In a valuable chapter regarding the future, the authors consider Europe as being the continent where conditions are most favourable

for a unified regime of inland water transport; these conditions include physical configuration, technical development, and economic and political outlook. It is pointed out that the interests of transport have to be reconciled in many cases with regularisation and canalisation schemes, artificial canals, hydro-electric undertakings, flood protection, irrigation, and other aspects of ever-developing engineering science. In the course of time developments are taking place in all these matters so that one of them may rise from insignificance to prime importance—thus dislocating and bringing trouble to a harmonious system. The steps necessary to satisfy one of these developments may conflict head-on with other requirements.

Instances of trouble arising between countries in the navigation of international waterways are stated in the book and these are valuable in giving us an insight into the actual problems involved. That they are not easy to solve is shown by such mutually well-intentioned States as Canada and the United States which recently have failed anew to agree on a scheme affecting the St. Lawrence and the Great Lakes for deepening the navigation and the development of hydraulic power. One source of disagreement has been the diversion of water from the Great Lakes for sanitary purposes by the city of Chicago. The following order of precedence in the use of boundary waters was established by Treaty between the two States: 1st, domestic and sanitary; 2nd, navigation; and 3rd, power and irrigation.

The book is illustrated by two excellent diagrams showing clearly the Belgo–Dutch and the Central European waterways. D. A. S.

Heresies and Humours. By Major C. S. Jarvis, C.M.G., O.B.E. Demy 8vo. Pp. 176. Illustrated by R. A. Young. London: Country Life Ltd., 1943. *Price* 8*s* 6*d*.

The former Governor of Sinai is well known to readers of *Blackwood's Magazine* and to a still wider circle for his brilliant sketches of desert life, *Yesterday and To-day in Sinai*. In his new volume, *Heresies and Humours*, he is in a lighter vein, and fun and humour sparkle from its pages, which are a godsend to the war-weary reader. Though the slim volume is intended for lighter moments, it also contains much of interest and importance to the scientist and naturalist, and the chapters on the Libyan fauna, on Water, and on Sand contain much first-hand information regarding wild life, irrigation, and road-making in Libya and Sinai, which should be of much value to our troops in these regions to-day. R. A. Young's amusing cartoons enhance the attraction of this happy little volume. I. W. H.

HYDRO-ELECTRIC SCHEME

In order to safeguard the life and scenery of the Scottish Highlands which may be injuriously affected by the work of the North of Scotland Hydro-Electric Board, the Council of the Association for the Preservation of Rural Scotland has issued a special Hydro-Electric Fund Appeal, signed by the Chairman, the Rt. Hon. The Earl of Galloway. The Fund will be used to meet expenses incurred in presenting the case of the Association at inquiries, or in opposing any harmful schemes.

ROYAL SCOTTISH GEOGRAPHICAL SOCIETY

PROCEEDINGS

Meetings of Council were held on the 5th December 1944 and the 9th January 1945.

Medal Awards, 1944-45, and Diploma

The Society's Gold Medal: James M. Wordie, B.Sc., F.R.G.S., Fellow of St. John's College, Cambridge, for distinguished services to Polar Exploration.

The Livingstone Gold Medal: Major N. E. Odell, F.R.G.S., Clare College, Cambridge, for services to exploration rendered in Spitsbergen, Canada, Northern Labrador, Greenland, Nanda Devi and Mount Everest.

The Society's Research Medal and Diploma of Fellowship: Professor Alan G. Ogilvie, O.B.E., M.A., B.Sc., for important services rendered to the science and teaching of Geography during the past twenty-five years.

Mungo Park Medal: Frank Fraser Darling, D.Sc., Ph.D., for his notable contribution to scientific knowledge of the Highlands and Islands of Scotland.

Newbigin Prize: Miss Catherine P. Snodgrass, M.A., Ph.D., for her valuable contributions to *The Scottish Geographical Magazine*.

ADDITIONAL LECTURE

An additional lecture will be held on Wednesday, April 25th, at 3 p.m. in the Lothian Road Church Hall: Allan Arthur, M.I.C.E., M.I.E.E., on "The Future of the Scottish Highlands as affected by Hydro-Electric Projects." Illustrated.

FELLOWS HONOURED

Professor R. N. Rudmose-Brown and Mr. J. M. Wordie have received permission from His Majesty the King to wear the insignia of a Commander of the Order of St. Olav conferred on them by His Majesty King Haakon in recognition of services rendered.